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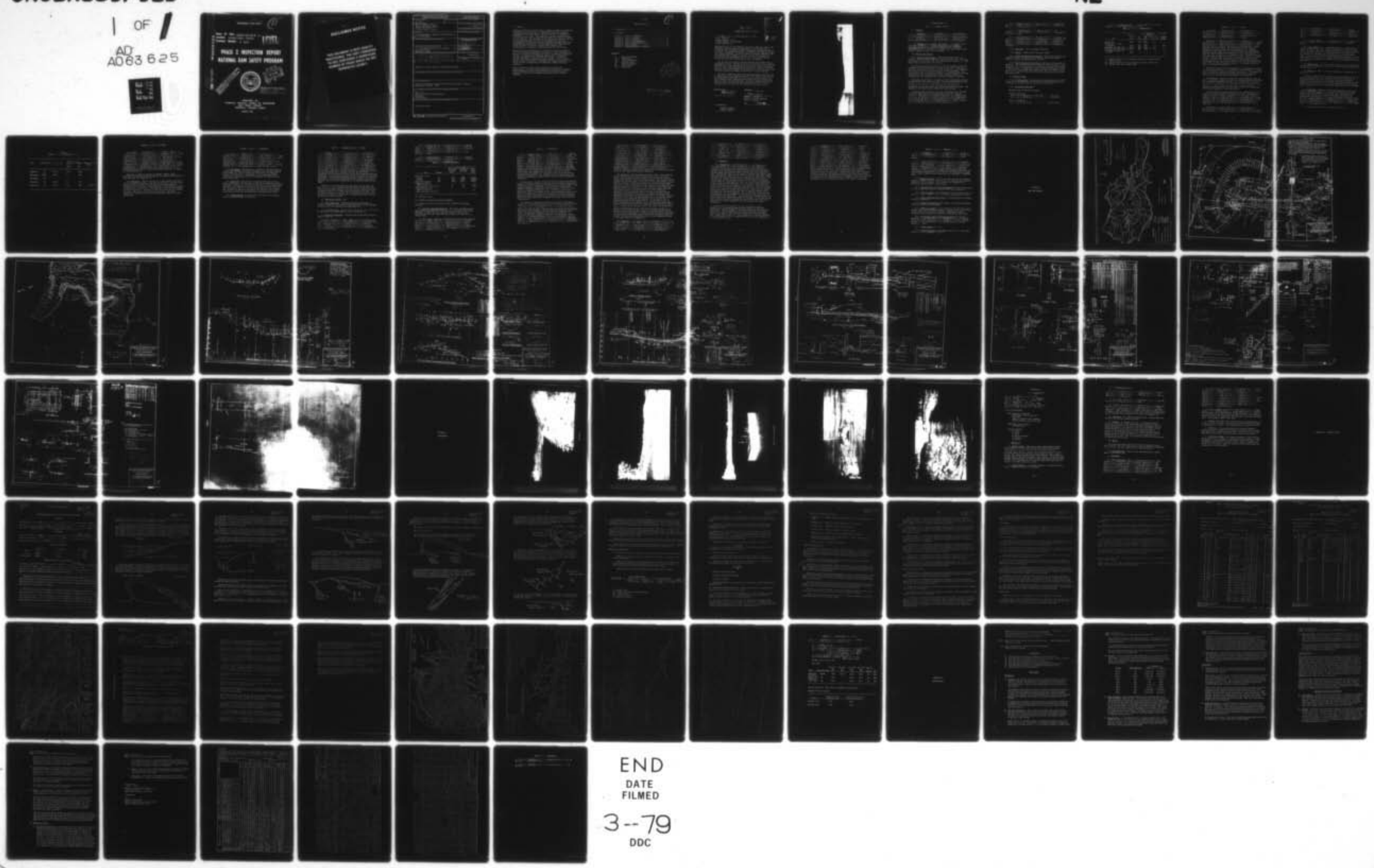

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RAPPAHANNOCK RIVER BASIN

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Name Of Dam: MOUNTAIN RUN DAM NO. 50
Location: CULPEPER COUNTY, VIRGINIA
Inventory Number: VA 04703

LEVEL II

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

U.S. ARMY CORPS OF ENGINEERS NORFOLK DISTRICT

PREPARED BY
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

AUGUST 1978

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

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PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam: Mountain Run No. 50 Dam #VA 04703
State: Virginia
County: Culpeper County
USGS Quad Sheet: Culpeper West
Stream: Mountain Run

Mountain Run No. 50 is an earthfill structure 1,000 feet long and 38 feet high. The principal spillway consists of a drop inlet to a 66-inch diameter reinforced concrete pipe running through the dam at a low level. The emergency spillway is a 300-foot wide vegetated earth side channel spillway. The dam is located on Mountain Run about 3/4 mile upstream from Culpeper, Virginia. The dam was designed and constructed under the supervision of the U. S. Soil Conservation Service and is presently owned by the town of Culpeper.

The spillway will pass the Probable Maximum Flood (PMF) without overtopping the dam. The PMF was based on breaching of three upstream dams which were previously constructed with each capable of passing a flood no larger than 1/2 PMF without overtopping the dam. Therefore, based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the spillway is rated as adequate.

The visual inspection revealed no apparent problems and there are no immediate needs for remedial measures. The slopes of the dam meet the requirement recommended by the U. S. Bureau of Reclamation for zoned earthfill dams. The actual embankment structure appears to be similar to the "as-built" drawings. The dam is adequate for normal pool operation, but the check on slope stability under the full loading conditions cannot be made without construction records.

Submitted by:
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DOUGLAS L. HALLER
Colonel, Corps of Engineers
District Engineer

DATE 30 AUG 1978

Recommended by:

Original signed by
ZANE M. GOODWIN

OVERVIEW FROM DISCHARGE CHANNEL OF EMERGENCY SPILLWAY

50

MOUNTAIN RUN NO. 50

SECTION 1 - PROJECT INFORMATION

1.1 General:

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (See Reference 1, Appendix VII). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: Mountain Run Dam No. 50 is an earthfill structure about 1,000 feet long and 38 feet high. The top of the dam is 14 feet wide and is at elevation 403.1 feet m.s.l. Side slopes are 2.5 horizontal to 1 vertical.

The principal spillway consists of a 66-inch diameter reinforced concrete pipe, running through the dam at a low level. This pipe is served by a drop-inlet structure (riser) located in a low elevation of the reservoir just upstream from the heel of the embankment. The crest of the riser is at elevation 384.9. A concrete outlet structure is provided at the downstream end of the principal spillway so discharge will not jeopardize the structural integrity of the dam.

The emergency spillway is a vegetated earth side-channel spillway located off the north end of the dam. It has a bottom width of about 300 feet with a crest at elevation 391.2 and side slopes of 3 horizontal to 1 vertical. Selected topsoil is placed in 4" thicknesses on the side slopes and on the bottom of the spillway. The topsoil is well compacted on the bottom of the spillway.

A 30-inch round corrugated metal pipe with invert at a low level (elevation 366) enters the upstream side of the riser from the reservoir. This permits withdrawal of water from the bottom of the reservoir. An 18-inch reinforced concrete pipe used to supply water downstream to the town of Culpeper, Virginia runs through the dam parallel with the 66-inch pipe leading from outside of the riser and discharges from the right wall of the discharge outlet.

1.2.2 Location: Mountain Run Dam No. 50 is located on Mountain Run, 3/4 mile upstream of Culpeper, Va. The reservoir formed by the dam is known locally as Pelham Lake.

1.2.3 Size Classification: The dam is classified as an "intermediate" size structure because of its maximum storage potential of 10,000 acre-feet.

1.2.4 Hazard Classification: The dam is located in an urban area and is therefore given a high hazard classification in accordance with guidelines contained in Section 2.1.2 of Reference 1, Appendix VII. The hazard classification used to categorize dams is a function of locaton only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: Town of Culpeper, Virginia

1.2.6 Purpose: Flood control and water supply.

1.2.7 Design and Construction History: The dam was designed and constructed under the supervision of the U.S. Soil Conservation Service. Construction was completed in 1972.

1.2.8 Normal Operational Procedures: Operation of the project is automatic. The principal spillway is ungated, therefore water rising above the crest of the drop inlet is automatically passed downstream. Similarly water is automatically passed through the emergency spillway in the event of an extreme flood which fills the flood storage space. Water can be withdrawn from the conservation storage space as needed for water supply.

1.3 Pertinent Data:

1.3.1 Drainage Areas: The dam controls a drainage area of 23.90 square miles including areas totalling 14.08 square miles which are controlled by dam Nos. 8-A, 11, and 13 located upstream.

1.3.2 Discharge at Dam Site:

Maximum flood at dam site not known.

Principal Spillway:
Pool level at emergency spillway crest . . . . 607 c.f.s.
Pool level at top of dam . . . . 740 c.f.s.

Emergency Spillway:
Pool level at top of dam . . . . 40,060 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

Table 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet m.s.l.	Area acres	Reservoir Capacity Acre feet	Reservoir Capacity Watershed inches(a)	Length miles
Top of dam	403.1	700	10000	19.1	-
Maximum pool, design surcharge	393.5	455	4940	9.4	2.6
Emergency spillway crest	391.2	400	4037	7.7	-
Principal spillway crest (b)	384.9	254	1942 (c)	3.7	2.1
Streambed at centerline of dam	365±	0	0	0	0

(a) Based on 9.82 sq. mi., excluding 14.08 sq. mi. controlled by upstream dams.

(b) Top of conservation pool and bottom of flood control pool.

(c) Sediment 942, water supply 1000.

SECTION 2 - ENGINEERING DATA

2.1 Design: The dam was designed and constructed under the direction of the U.S. Soil Conservation Service. As-built drawings and complete design data are available in the office of the State Conservationist, U.S. Soil Conservation Service, P.O. Box 10026, (Federal Building, Room 9201) Richmond, Va. 23240.

A geologic (foundation) investigation was conducted at the site by the SCS during the initial design stages. The investigation included drilling 12 core borings and 45 hand auger holes and excavating 78 test pits along the proposed dam alignment, principal and emergency spillways and borrow areas. The core borings were drilled into bedrock and pressure tested down to impermeable rock. Depth to impermeable rock ranged from 17 to 70 feet along the dam alignment. Multiple, constant head field permeability tests were conducted in each core hole in addition to the pressure tests. The test pits were excavated with an industrial tractor to a depth of 11 feet or refusal on rock. Geologic logs and profiles were prepared from the core borings and test pits. A detailed geologic report with foundation recommendations was also prepared based on the core drilling and test pits, field testing and geologic mapping. The geologic report and maps are inclosed in appendix IV.

Referring to Plate III and IV, Appendix I, the embankment is built on residual and alluvial soils underlain by bedrock which is a complex system of sandstone, shale, siltstone and greenstone. The bedrock has been subjected to considerable faulting and there are extensive breccia zones which may be highly permeable in some places.

The embankment structure consists of a zoned compacted earth dam with a core trench. Where the core trench encountered the fault zone, the recommended foundation treatment is to excavate the fault zone material 5 feet below the base of trench and backfilled with compacted MH material. Where the core trench bottom resting on fresh or moderately weathered rock, the rock surfaces were to be cleaned and slushed grout applied to cracks and joints.

The alluvium layer along the stream valley, varying from 6 - 13 feet thick, consists mostly of SM and ML materials. The abutments consist of weathered rock or residual soils. The zone I material forming the upstream slope and core of the dam consists of ML and MH material. The zone II material forming the downstream shell of dam consists of SM, GM and GP materials. A summary of engineering properties of the foundation and embankment materials are given in Table 2.1.

To control the phreatic surface and to collect seepages, a drainage system is located under the downstream portion of the dam. The system consists of a trench running parallel to the axis of dam, 4

feet wide and with bottom at bedrock, filled with graded filter material, and an intercepting trench with 10" diameter perforated pipe running parallel to the principal spillway into the stilling basin. Six anti-seep collars were built around the principal spillway under the upstream and center portion of the dam to control the problem of piping.

The emergency spillway located at the left abutment is formed by a cut into materials consisting of weathered rock, ML, MH and SM materials.

The slope stability was checked with the Swedish circle and the sliding block methods. The sliding block analysis showed the lowest factor of safety. With full drawdown condition, the factor of safety is 1.42 for the upstream slope which has slopes 1 vertical on 2½ horizontal over 1 vertical on 3 horizontal below the normal pool level. The 1 vertical on 2½ horizontal downstream slope has a factor of safety of 1.50 under steady seepage condition and a drain at c/b = 0.6. Additional information on stability is given in Section 6 and in Appendix V.

2.2 Construction: The construction records were not furnished by the SCS Office in Richmond, but they are available from the SCS Office in Washington, D. C.

2.3 Operation: There is no known operation or instrumentation procedure.

In 1974, a subdrain system was built in an area beyond the toe of the dam, bounded by the right abutment and the stilling basin, to relieve the problem of excessive wetness in the area which was frequently used by golfers. The subdrains discharge through a 6-inch diameter pipe which is located at 20 feet downstream of the stilling basin. No information on the design and construction of the subdrains was available.

2.4 Evaluation: Refering to Plate III, Appendix I, the cutoff trench at the right abutment in the "as-built" case was shallower than the depth recommended by the design. More importantly, the cutoff trench did not extend into the abutment rock as deep as recommended by the design. The wetness in the area beyond the toe at the right abutment indicated in paragraph 2.3, Section 2 can be caused by seepage from inadequate cutoff trench construction. Although the seepage condition is not serious at the normal pool level, the seepage flow should be closely monitored.

See Section 6.3 for evaluation of the dam stability.

TABLE 2.1
SUMMARY OF SOIL OF ENGINEERING DATA

Item	Classification	Dry Unit Wt. pcf	Consolidated Undrained Strength ∅ degree	c psf	Compressibility ft/ft
Embankment	ML	91-107	23.5	1250	-
Embankment	ML-MH	80-98	19	1150	-
Embankment	SM	-	-	-	-
Foundation	SM	82-103	22	150	-
Foundation	ML	62-90	15.5	800	.04-0.6

SECTION 3 - VISUAL INSPECTION

3.1 Findings: Field observations are outlined in Appendix III. The visual inspection revealed several minor problems. Although there is good growth of grasses on the embankment and crest, the areas within the golf course are trimmed too short. The concrete stilling basin is experiencing concrete deterioration. The riprap in the downstream channel is failing with vegetation growing among the rocks. Also there is vegetative growth in the upstream slope riprap. Colloidal sediment was evident in foundation drain pipes. The dam had no staff gages or instrumentation. There was no access to the riser. A manhole cover was missing from the top of the riser. About 0.4 miles downstream of dam is a fence traversing the stream. The fence was collecting debris.

There was no apparent evidence of leakage, erosion, undue settlement and seepage, slope instability, nor improper functioning of water passages and seepage drain.

3.2 Evaluation: Overall, the dam is in good condition and needs only minor remedial measures. The concrete spillway is deteriorating and will result in exposing reinforcing bars and weakening the integrity of the structure. Excessive growth in the riprap encourages the undermining of protection. The downstream riprap failure enhances erosion of the stream. The grass in the golf course has been trimmed too close, exposing the root structure to erosion. The fence downstream of the dam can serve as a potential obstruction to normal stream flow.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: Operation of the project is automatic. The 66-inch diameter principal spillway is ungated, therefore water rising above the crest of the drop-inlet is automatically passed downstream. This in turn automatically maintains the pool level at or near elevation 385 ft. m.s.l. most of the time. Water is automatically passed through the ungated emergency spillway in the event of an extreme flood which fills the flood storage space. Water is withdrawn from the conservation storage space as needed for water supply.

4.2 Maintenance: Maintenance of the project consists mainly of fertilizing, liming, and mowing the embankment and spillway; seeding and mulching bare areas; painting the trash racks; and repairing gullies that might occur. Maintenance of the downstream channel consists of controlling vegetation and removing any debris, bars or other obstructions.

4.3 Inspection: The project is inspected annually to insure proper maintenance. The inspection of one dam is conducted as part of the annual inspection of the works of improvement in the Mountain Run Watershed. The inspection team consists of representatives from the town of Culpeper, the U. S. Soil Conservation Service, the Virginia Soil and Water Conservation Commission, the Culpeper Soil and Water Conservation District and the Mountain Run Watershed Association.

4.4 Warning System: At the present time, there is no warning system or evacuation plan in operation.

SECTION 5 - HYDRAULIC/HYDROLOGIC DESIGN

5.1 Design: The elevation of the crest (elevation 384.9) of the drop inlet to the principal spillway was established at an elevation which would provide the conservation storage needed for sediment deposit and water supply. The discharge capacity (607 c.f.s. with reservoir level at crest of emergency spillway) of the principal spillway was established by consideration of a number of factors including (1) the capability of evacuating the flood storage space within a reasonable time (± 10 days), (2) not passing damaging flows downstream, and (3) the capability of the reservoir to store flood waters. The crest (elevation 391.2) of the emergency spillway was established at the maximum elevation reached in routing the principal spillway hydrograph which resulted from the 100-year 10-day rainstorm. The elevation of the top of the dam (elevation 403.1) was established by the maximum elevation reached in passing the freeboard hydrograph. The freeboard hydrograph is that computed from rainfall comparable to the Probable Maximum Rainfall as used by the Corps of Engineers and is therefore comparable to the Probable Maximum Flood (PMF).

Dam No. 50 is located downstream from three similar dams, Nos. 8-A, 11 and 13. These upstream dams were design by the SCS on the basis of low standard design criteria and are not capable of passing the PMF but will pass 1/2 PMF without overtopping these dams. The freeboard hydrograph for Dam No. 50 is based on the assumption that the three upstream dams deteriorate in the PMF and release all their storage over a 5-hour period.

5.2 Hydrologic Records: None

5.3 Flood Experience: Flooding during Hurricane Agnes in Culpeper in June 1972 was reduced significantly by this dam although it was not entirely completed until September 1972.

5.4 Flood Potential: Design features of the dam were established by routing various hydrographs as noted in paragraph 5.1.

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in table 1.1.

Except for withdrawal for water supply, regulation of flow from the reservoir is automatic. Water rising above the crest of the drop inlet flows into this inlet and through the dam in the 30-inch concrete conduit. Water also flows past the dam over the ungated emergency spillway in the event water in the reservoir rises over the crest of the spillway.

Outlet discharge capacity, reservoir area and storage capacity data, and hydrograph and routing determinations were obtained from reports and computations furnished by the Soil Conservation Service (SCS). The routing of the emergency spillway and freeboard hydrographs began with the reservoir level at the crest of the principal spillway.

5.6 Overtopping Potential: The probable rise in the reservoir and other pertinent information on reservoir performance in various hydrographs is shown in the following table:

Table 5.1 RESERVOIR PERFORMANCE

Item	Normal	Hydrograph Principal Spillway (a)	Hydrograph Emergency Spillway	Hydrograph Free-Board (b)
Peak flow, c.f.s.				
Inflow	10	N/A	7,000	48,000
Outflow	10	607	3,200	40,800
Peak elev., ft. msl	385	391.2	393.5	403.1
Emergency Spillway				
Depth of flow, ft.	-	0	2.3	11.9
Avg. velocity, f.p.s.(c)	-	0	4.5	10.2
Non-overflow section				
Depth of flow, ft.	-	-	-	0
Avg. velocity, f.p.s.(c)	-	-	-	-

(a) 100-year flood.

(b) Probable maximum flood by COE standards.

(c) Maximum velocity at crest about 150 to 200% of the average velocity.

5.7 Reservoir Emptying Potential: The 30-inch corrugated metal pipe entering upstream side of the riser at a low level will permit withdrawal of about 94 c.f.s. with the reservoir level at the principal spillway crest and essentially dewater the reservoir in about 2 weeks.

5.8 Evaluation: Hydrologic and hydraulic determinations prepared by the SCS as a basis for design of the project appear reasonable. The emergency spillway will pass a feeboard hydrograph which is essentially equal to the PMF. The freeboard hydrograph assumed breaching of the three upstream dams which were previously constructed with a lower hazard classification. The emergency spillway is therefore considered to be adequate.

SECTION 6 - DAM STABILITY

6.1 Foundation: Mountain Run Dam No. 50 is founded on residual and alluvial soils overlying metamorphic and sedimentary bedrock. The residual soils formed by weathering of the bedrock occur along both abutments. Along the channel section, the dam bears on alluvial soils deposited by Mountain Run. A 12-foot wide (base) cutoff or core trench keys the earth embankment into underlying weathered bedrock. A seepage drain, 4 feet wide, runs approximately 600 feet along the length of the dam 25 feet downstream of the centerline. The drain system is also founded on weathered bedrock and varies in thickness according to local foundation conditions. "As-built" drawings of the cutoff trench and seepage drain are shown on Plates IV and V, respectively, in Appendix I. A geologic report of the dam site is inclosed in Appendix IV. The remainder of this section deals with describing the geologic location of the dam site and the foundation conditions.

The dam site is located within the Piedmont Plateau Physiographic Province of Virginia which is underlain by predominately igneous and metamorphic rocks of Precambian to Cambian age. A narrow band of much younger sedimentary rocks comprising the Triassic Basin trends northeast-southwest through much of the Piedmont. A section of the basin cuts through the Culpeper area. The contact between the sedimentary rocks of the basin and the older metamorphic rocks to the west is a border thrust fault that intersects the City of Culpeper. Subsequent thrust and transverse faulting which occurred along the border area after the basin's formation has greatly complicated the local geology.

The dam site is located less than one mile west of the basin contact and is underlain by both Triassic sedimentary rocks and older metamorphic rocks. The metamorphic rocks are predominate. They comprise most of the left abutment, the entire channel section and part of the right abutment. The Precambiam age Catoctin and Lynchburg formations are the geologic units in which the metamorphic rocks occur. The Catoctin formation rocks, comprised primarily of greenstone with minor amounts of phyllite, is perdominate. Mica schist of the Lynchburg formation occurs in minor amounts under the channel section. Triassic sedimentary rocks including the Manassas Sandstone and Bull Run Shale underlie most of the right abutment and a thin zone of sandstone and siltstone underlies a small section of the left abutment.

The structural relationship between and within the Triassic sedimentary rocks and older metamorphic rocks is very complex. Several faults were recognized and roughly traced during the exploratory drilling. Two of the faults are fairly extensive, one under the right abutment where Triassic sedimentary rocks have been thrust over the older metamorphic rocks and another under the channel section within the Catoctin greenstone. Approximately 22.5 feet of brecciated greenstone occurs along the fault contact under the right abutment and 23.2 feet of brecciated materials occurs along the southward dipping contact under the channel section. The general strike of the Catoctin greenstone is N 35° E. The triassic sedimentary rocks strike N45° E and dip approximately 29° SE, but in some areas this orientation has been altered due to the faulting. Though jointing was fairly extensive, no prominent system was observed. During the Corp's visual inspection, verification was made as to the rock types and bedding orientations.

The condition of the foundation materials varies. The overlying soils especialy the alluvium under the channel section is fairly dense. The consistency of the residual soils are medium to hard as indicated by the blow counts on the boring logs. The thickness of the residual and colluvial soils capping most of the right abutment ranges from 23 to 35 feet. The alluvium along the channel section ranges from 6 to 13 feet in thickness and the residual soils capping the left abutment ranges from 8 to 25 feet. The condition of the underlying bedrock also varies. Generally, badly weathered, highly fractured rock underlies the soils and becomes less weathered and more impermeable with depth except within the fault zones where highly fractured and brecciated rock occurs. Competent, unweathered and impermeable rock occurs at depths ranging from 12 to 70 feet along the centerline of the dam. The geologic profiles in the geology report show the zones of weathered and competent rock as well as the recommended depth for the cutoff trench. As indicated in the "As Built" drawings, plate IV, Appendix I, the cutoff trench was placed in weathered bed rock well above the recommended depth, below the fault zones. A deep cutoff trench below the fault zones was recommended in lieu of grouting because of the anticipated expense and small hydraulic head behind the dam. The actual placement of the trench, however, was not below the fault zones, a decision probably made in the field during contruction. Construction reports were not available to confirm the actual grade depth or foundation conditions under the trench. The drain system was also placed into the weathered bedrock as indicated on plate VI, Appendix I.

6.2 Embankment: Referring to Plate IV, Appendix I, the crest of dam is 14 feet wide at El. 403.1. The upstream slope is 1 vertical to 2½ horizontal from the crest of dam to El. 381.9 where it flattens to 1 vertical to 10 horizontal forming a berm for a vertical distance of 1 foot. The slope then changes from 1 vertical to 3 horizontal to natural ground. 24" thick riprap over 12" of bedding material is

placed at upstream slope at El. 389.4 to the berm to protect the upstream shore at the normal pool operation. The core downstream slope is 1 vertical to 1.5 horizontal, and the core is covered with a downstream shell with a slope of 1 vertical to 2½ horizontal from the crest to toe of dam. The upstream slope and core is constructed with ML-MH material compacted in 9" lifts to 95% compaction at optimum moisture content. The downstream shell is constructed with SM, GM and GP material compacted in 24" lifts. Seepage drain is located in the pervious downstream shell 10 feet from the toe of the core.

6.3 Evaluation:

6.3.1 Foundation: Most dam foundations are evaluated on the basis of potential settlement, sliding and seepage. Excessive settlement of the dam is not a problem because the foundation is composed of fairly dense soils and weathered bedrock and settlement was not noted along the dam alignment during the visual inspection. Sliding within the bedrock is not usually a problem under small, earth dams. In addition, there are no adversely oriented weak planes within the foundation rock that would act as a potential sliding plane. The potential for seepage does exist within the foundation because the cutoff trench was not extended below the fault zones as recommended. It was, however, recommended that where the cutoff trench encountered a fault zone, the fault gouge was to be excavated 5 feet below the trench and backfilled with compacted core material. Where the trench bottom rested on fresh or moderately weathered rock, the rock surfaces were to be cleaned and slushed grout applied to fractures and joints. Construction records were not available to determine whether these treatments were actually employed. The low hydraulic head (less than 30') and high cost was probably the reason the cutoff trench was not extended below the fault zones. It was apparently determined that the drain system could effectively handle all seepage. At the time of the Corp's visual inspection, seepage from the toe drain was less than 1 gpm and no wet areas, developed since construction, were noted downstream.

Since additional seepage was not noted during the visual inspection, it is apparent that the drain system is effectively handling all leakage through the foundation materials including the fault zones. Due to presence of the fault zones below the cutoff trench it is possible that excessive seepage could develope during high (flood) water conditions. Close monitoring of the toe drain and the subdrain outlet should be required during high water conditions to determine unsafe seepage.

6.3.2 Embankment: The embankment slopes meet the requirement recommended by the U.S. Bureau of Reclamation for small zoned earthfill dams on stable foundation (Reference 2, Appendix VII). The design recommended an overbuilt of 1.0 feet to compensate for consolidation of the fill and foundation. The settlement is based on a compressibility of 2% for 37 feet of compacted fill and 20 feet of foundation. The embankment structure was checked with the Swedish circle and the sliding block methods. For both methods the pool level was at emergency spillway crest, El. 391.2. As the dam is built on stratified foundaton, the sliding block analysis showed the lowest factor of safety. Using a crest width of 14 feet and height of 37 feet, and 8 feet of foundation, the factor of safety for the upstream slope is 1.42 for the full drawdown condition. The factor of safety for the downstream slope is 1.50 for the steady seepage condition with drain located at c/b = 0.6. More information on the stability analysis is given in Appendix V. Although the partial pool condition is not investigated, the stability analyses were based on realistic soil data and if the embankment has been properly constructed, the dam is adequate for the loading condition at spillway crest. No undue settlement, crack, or seepage was noted at the time of inspection.

SECTION 7 ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: Reference 1, Appendix VII, recommends a Spillway Design Flood equivalent to the PMF. Since the PMF does not top the crest of the dam, the emergency spillway is considered adequate.

Based on the visual inspection and review of existing records, there is no apparent problem that would require immediate action for the normal pool conditions. The actual structure is similar to the as-built drawings given in Appendix I. Without the construction records, the stability of the embankment under designed loading conditions cannot be assessed although the embankment slopes meet the requirements recommended by the U.S. Bureau of Reclamation for small zoned earthfill dams on stable foundation (see Reference 2, Appendix VII).

7.2 Remedial Measures: There is no immediate need for remedial measures. However, the following actions are suggested and should be initiated within 12 months. These measures are suggested for monitoring and maintenance purposes only.

7.2.1 The grasses on the faces of embankment should be maintained in such a condition that will facilitate the annual inspection.

7.2.2 Allow the grass on the embankment within the golf course to grow to at least 4 inches. This is necessary to protect grass cover.

7.2.3 Repair deteriorating concrete in stilling basin to maintain structural integrity.

7.2.4 Remove woody vegetation in riprap. Also repair downstream riprap protection to avoid erosion.

7.2.5 Suggest to record the pool elevation, the flow rates of the seepage drain, and the subdrain whenever the pool lovel rises 3 feet or more above the normal pool elevation. Staff gage or other equivalent facility should be provided to indicate the pool level.

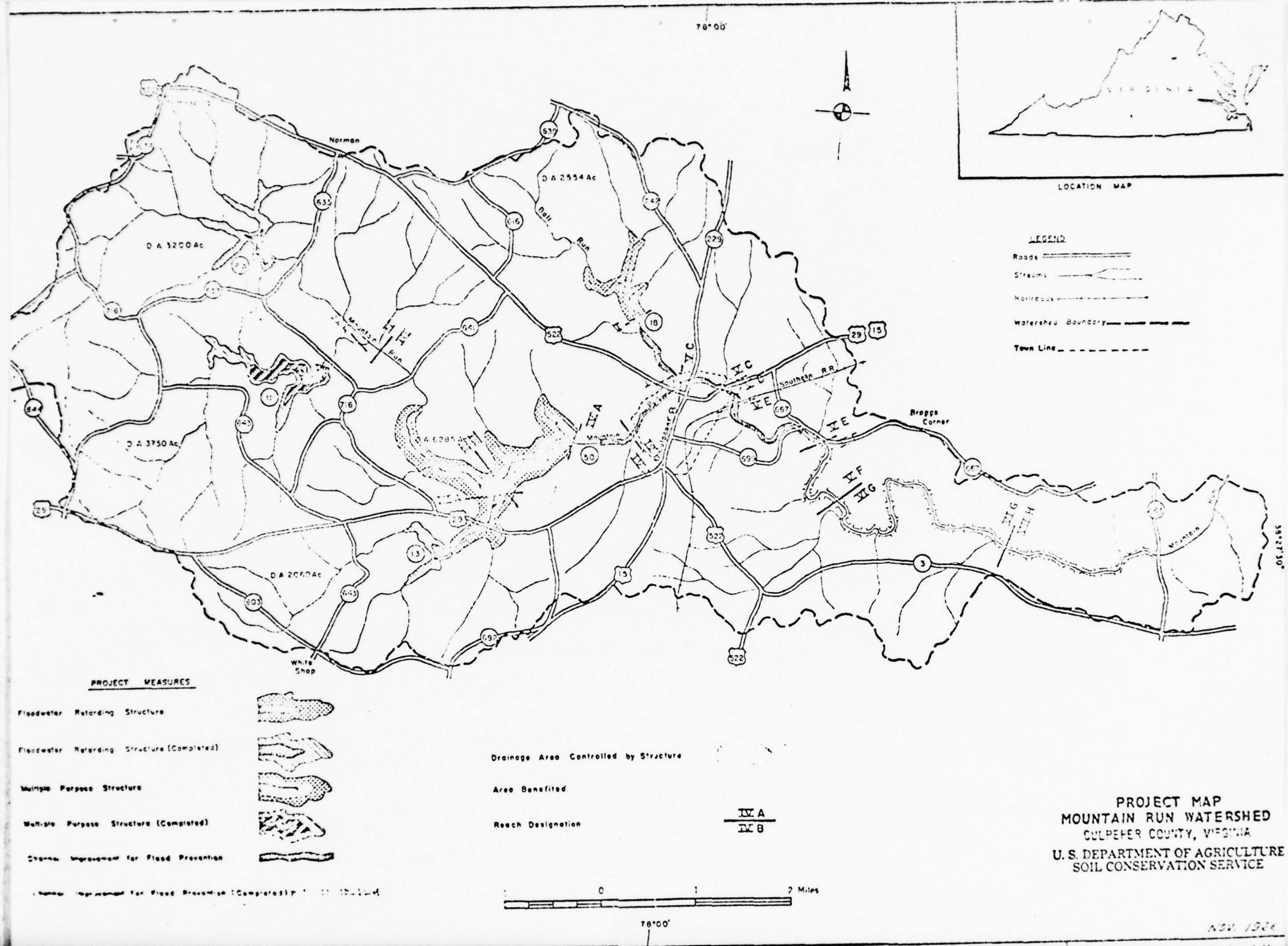
7.2.6 The current annual inspection program should include a measurement of the flow rates of the seepage drain and the subdrain. In the event that the drainage water is cloudy, an analysis of the suspended solids should be made to determine the source of the suspension solids.

7.2.7 Replace manhole on riser.

7.2.8 Include in regular maintenance, removal debris from fence located 0.4 miles downstream of dam.

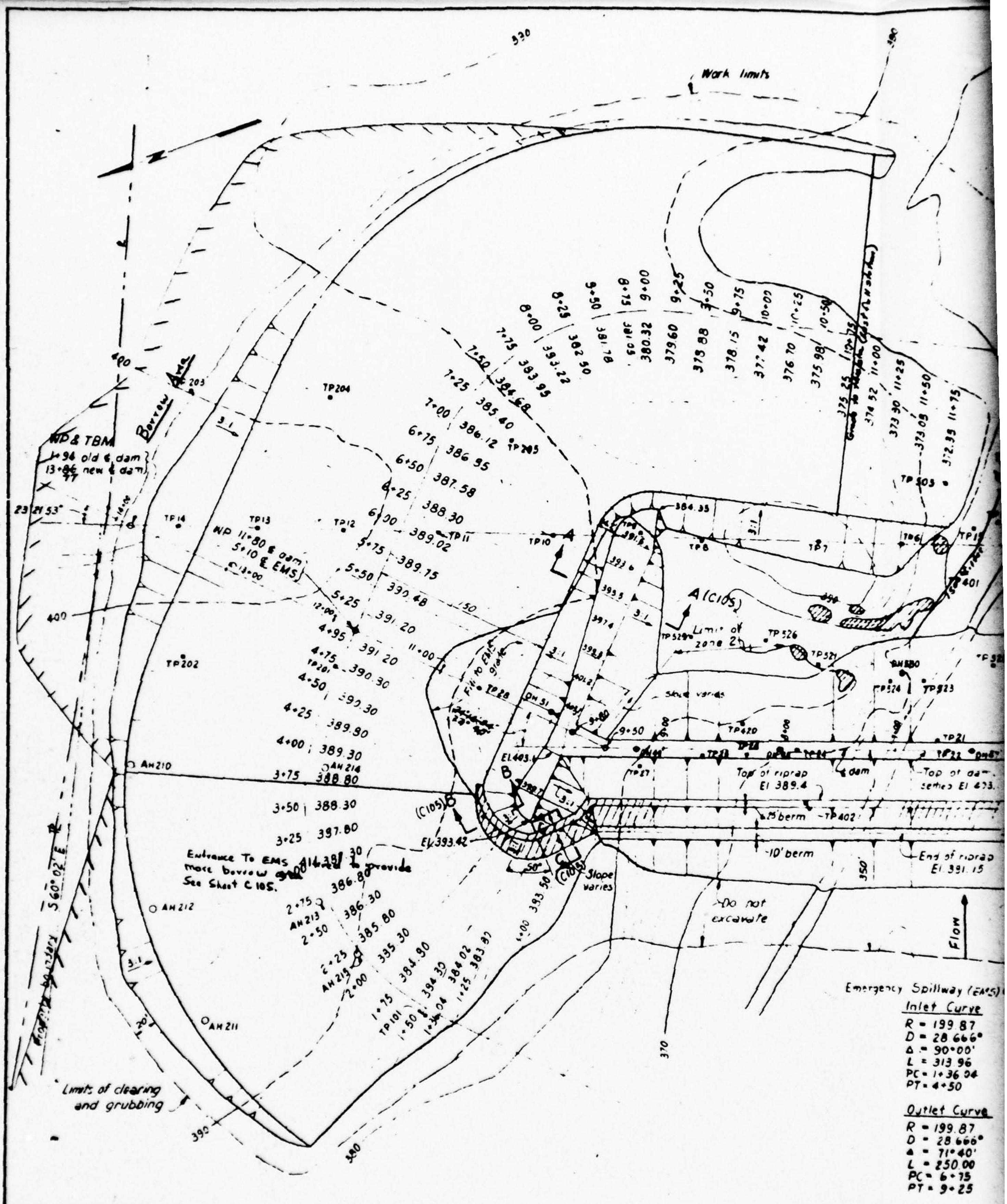
APPENDIX I

MAPS AND DRAWINGS



PROJECT MAP
MOUNTAIN RUN WATERSHED
CULPEPER COUNTY, VIRGINIA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

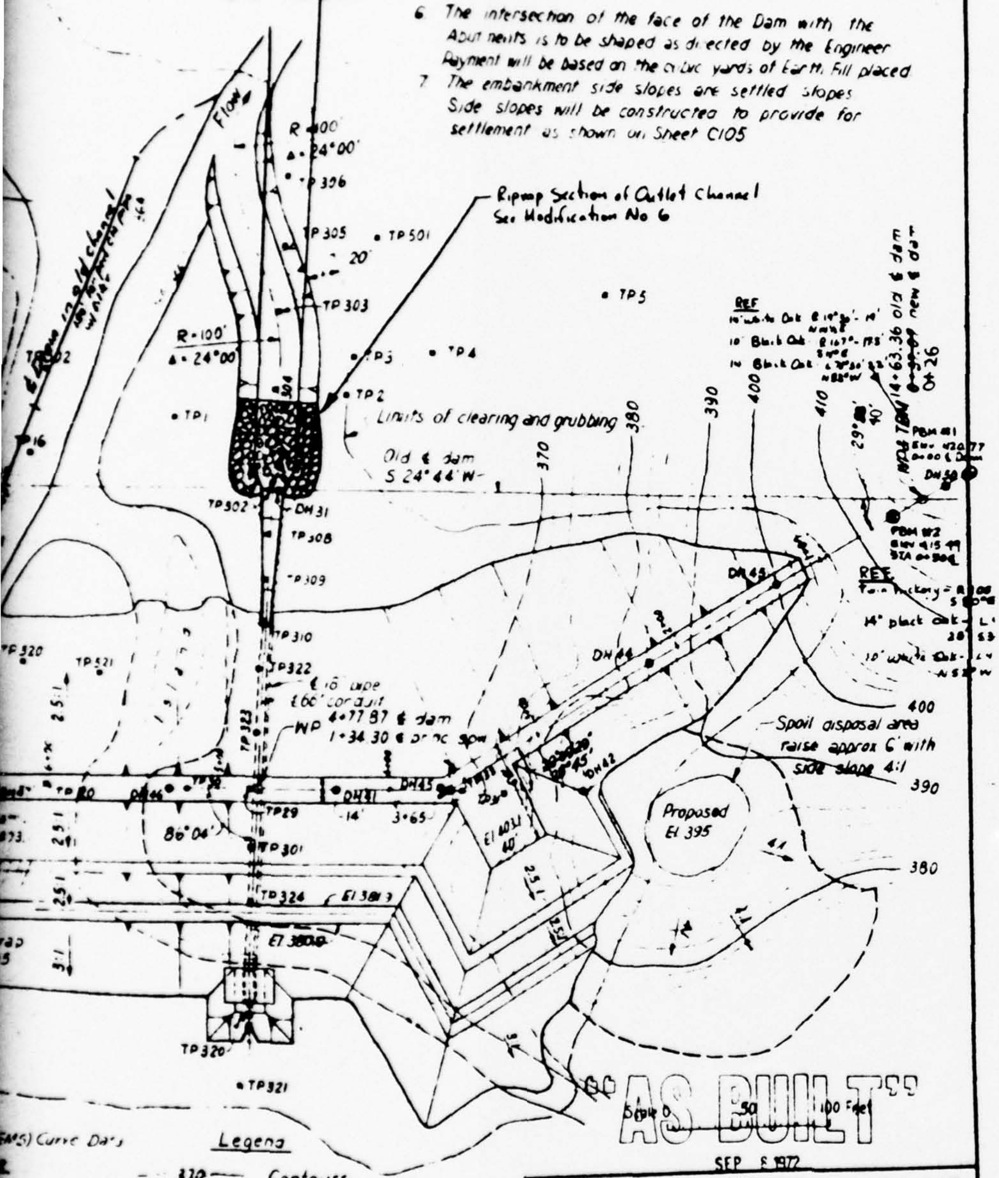
NOV. 1966



Work limits
Borrow Area
WP & TBM
1+94 old ℄ dam
13+86 new ℄ dam
WP 11+80 ℄ dam
5+10 ℄ EMS
Limit of zone 2
A (C105)
Top of riprap
El 389.4
℄ dam
Top of dam
25' berm
10' berm
End of riprap
El 391.15
Do not excavate
Slope varies
Flow
Entrance To EMS
See Sheet C105.
Limits of clearing and grubbing
S60°02' E
Emergency Spillway (EMS)
Inlet Curve
R = 199.87
D = 28.666°
Δ = 90°00'
L = 313.96
PC = 1+36.04
PT = 4+50
Outlet Curve
R = 199.87
D = 28.666°
Δ = 71°40'
L = 250.00
PC = 6+75
PT = 9+25

GENERAL NOTES

1. Areas under the Dam Emergency Spillway Access Road Normal pool area to El 385.4 and Borrow Area are to be cleared and grubbed
2. Topsoil shall be removed from under the Fill Areas as directed by the Engineer
3. Sufficient selected topsoil shall be stockpiled and placed at the minimum depth of 4 inches on the Emergency Spillway side slopes. Topsoil or other select material will be place on the outer faces of the Embankment in the course of construction and will be paid for as Earth Fill
4. The bottom of the Emergency Spillway is to be excavated 1 foot below finished grade and backfilled with Class A Compacted Fill selected by the Engineer
5. No excavation for Borrow Material is to made within 350 feet of the ℄ of the Dam.
6. The intersection of the face of the Dam with the Abutments is to be shaped as directed by the Engineer. Payment will be based on the cubic yards of Earth Fill placed
7. The embankment side slopes are settled slopes. Side slopes will be constructed to provide for settlement as shown on Sheet C105



SEP 8 1972

Legend

370	Contours
	Rock outcrops
	Equipment placed riprap
	Building
• TP4	Test pit
• DH 49	Drill hole
○ AG 211	Auger hole
WP & TBM	Work point and Temporary bench mark established by SCS
	Cut
	Fill

MOUNTAIN RUN WATERSHED PROJECT
MULTIPLE PURPOSE DAM SITE NO 50
CULPEPER COUNTY, VIRGINIA
LAYOUT DAM & SPILLWAY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

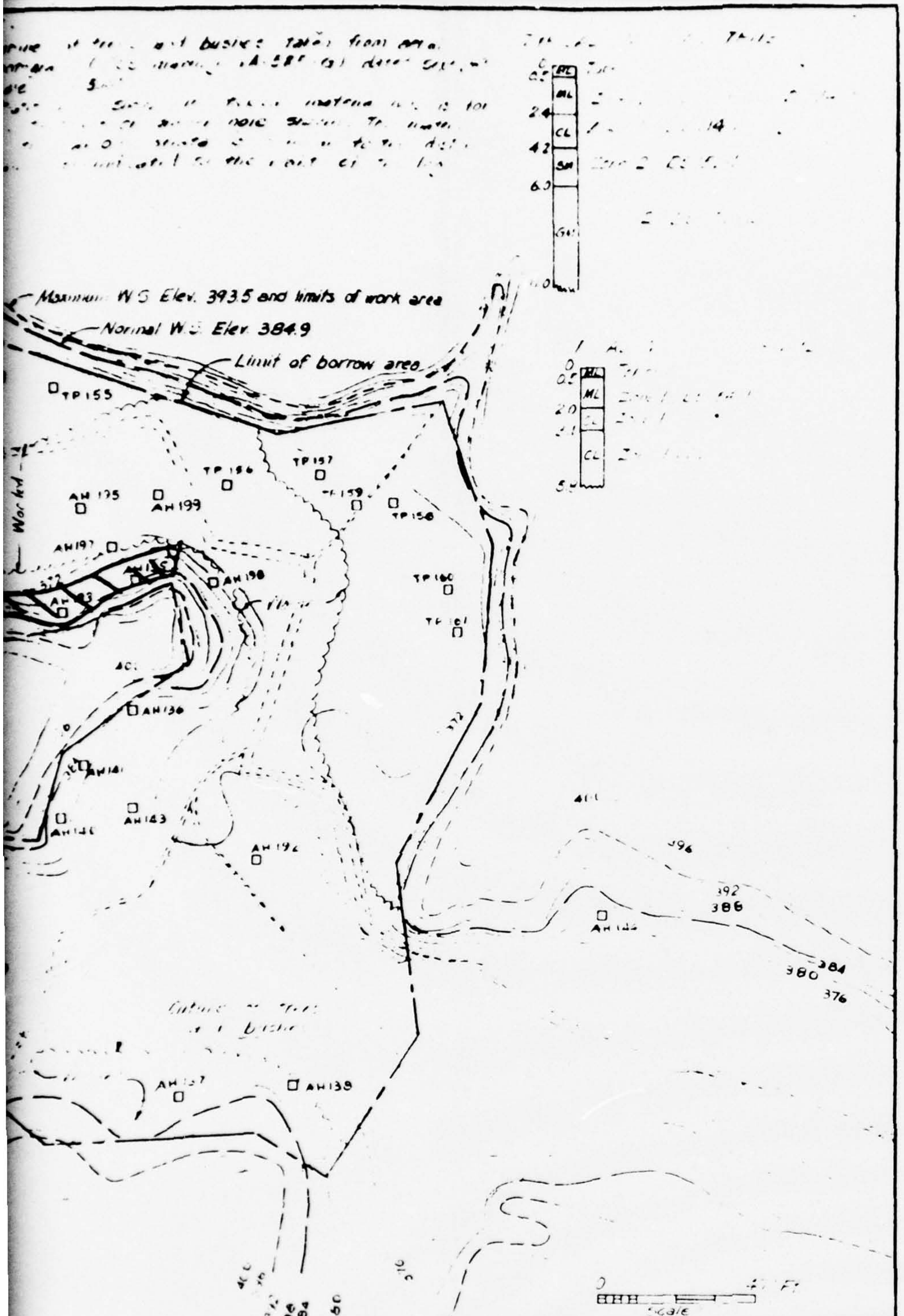
Designed | Drawn TEG | Traced | Checked | Date | Approved by | Title | Sheet | Drawing No. C101

2

SCS-313 (9-64)

PLATE I

Limit of
borrow area
400
TP 123
TP 181
TP 160
AH 132
AH 136
AH 139



MOUNTAIN RUN WATERSHED PROJECT
MULTIPLE PURPOSE DAM SITE NO 50
CULPEPER COUNTY, VIRGINIA

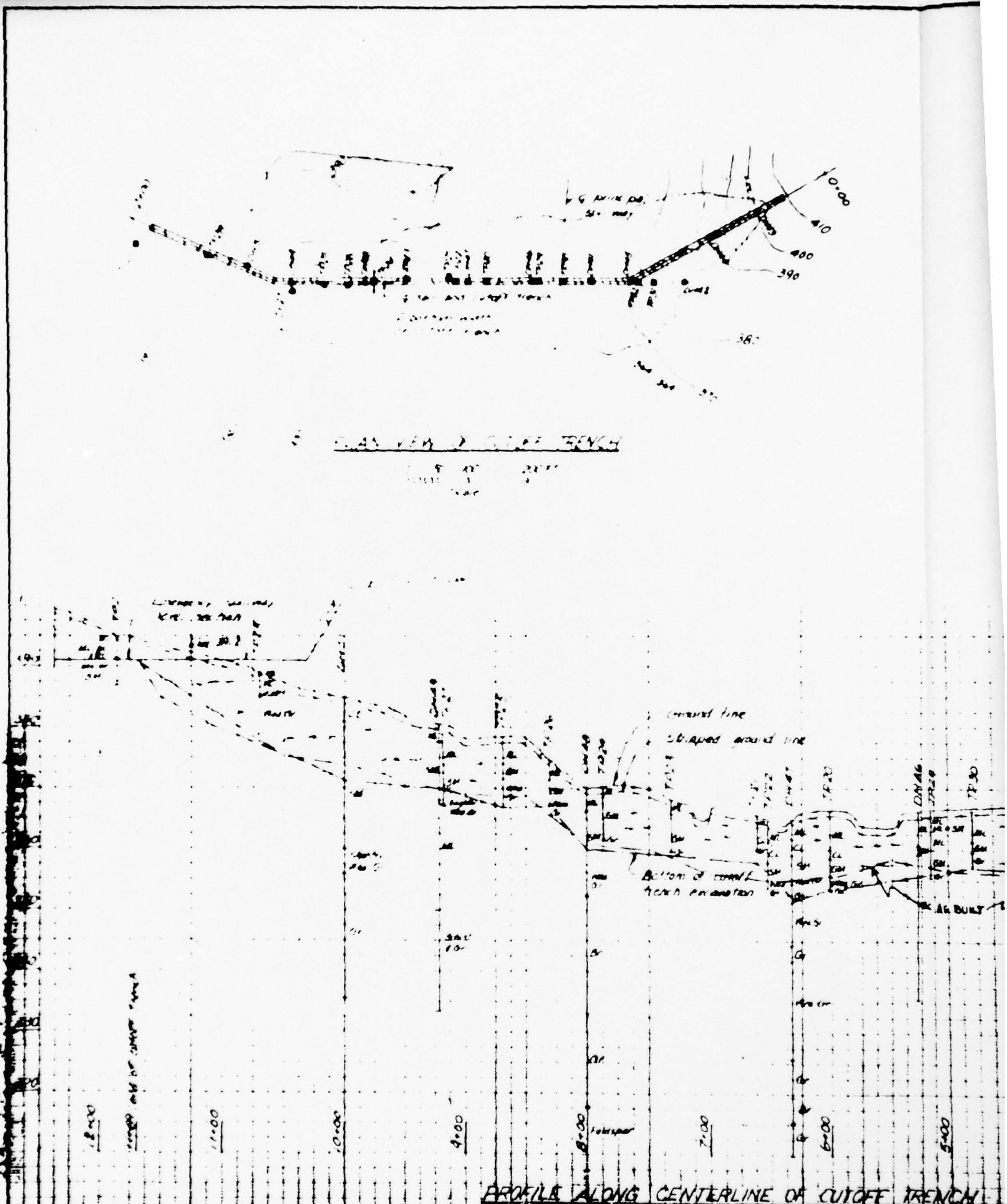
PLAN OF BORROW AREA

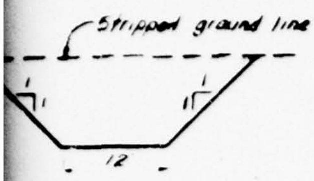
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

"AS BUILT"
SEP 8 1972

2

SCS-313-C(9-64) [redacted] PLATE II


0+00
410
400
390
380
Ground line
Stripped ground line
Bottom of cutoff trench excavation
AS BUILT
DH46
TP29
TP30
12+00
11+00
10+00
9+00
8+00
Feldspar
7+00
6+00
5+00
PROFILE ALONG CENTERLINE OF CUTOFF TRENCH



CAL SECTION THROUGH CUTOFF TRENCH

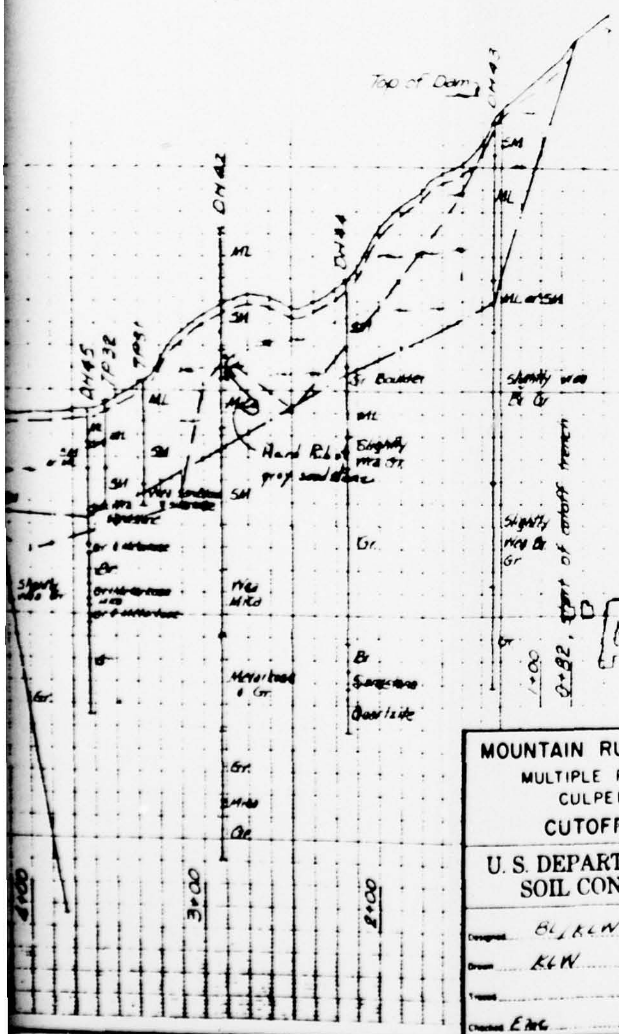
CONSTRUCTION DETAILS

1 The excavation limits are approximate and will be adjusted in accordance with conditions encountered.

2 Rock exposed in the bottom of the cutoff trench shall be thoroughly cleaned and will be inspected by the Engineer prior to the placement of compacted fill material.

NOTES

1 Abbreviations in addition to symbols of unified soil classification
Wea - Weathered Gr - Greenstone ;
Br - Breccia



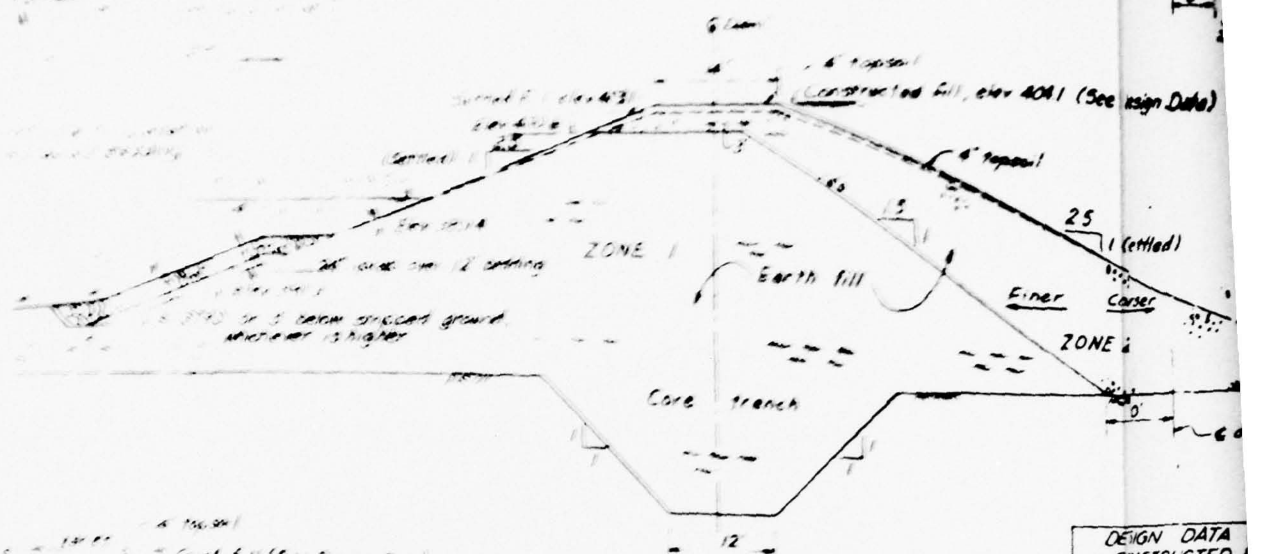
"AS BUILT"
SEP 8 1977

MOUNTAIN RUN WATERSHED PROJECT
MULTIPLE PURPOSE DAM SITE NO. 50
CULPEPER COUNTY, VIRGINIA
CUTOFF TRENCH DETAILS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date		
Designed	BL/KLW	4/23/7_	Approved by	LEE
Drawn	KLW	4/26/7_	Title	
Traced			Title	
Checked	EHG	7/1/7_	Sheet No.	Drawing No. C104

FORM SCS - 313 1 PLATE III

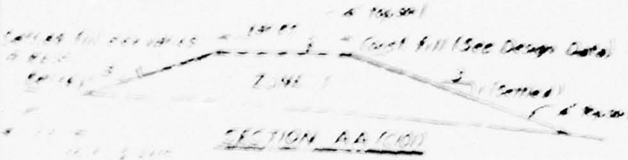


TYPICAL SECTION OF EMBANKMENT

Sta 1+12 to Sta 9+50

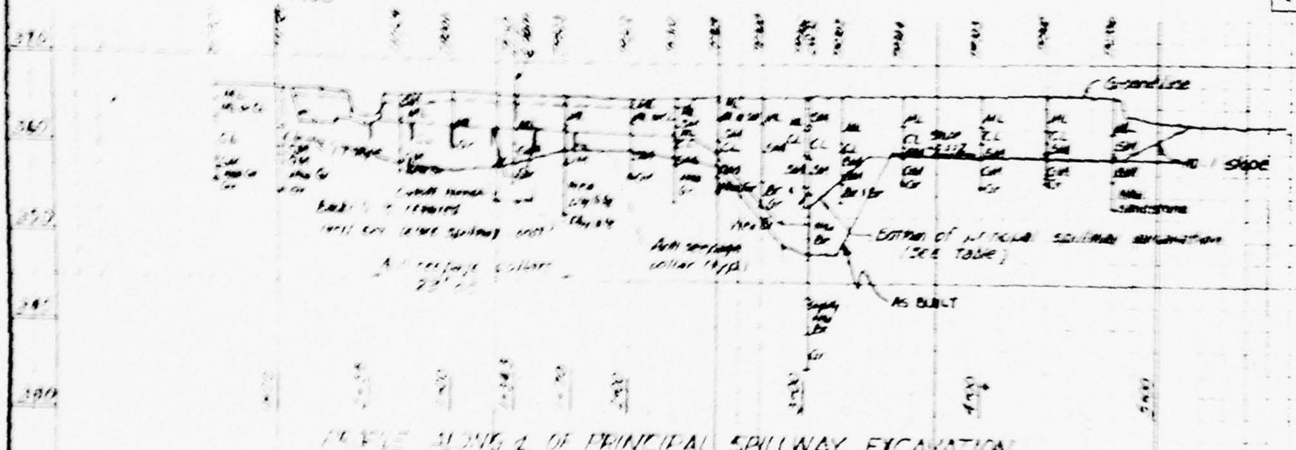
0 10 Ft

Scale

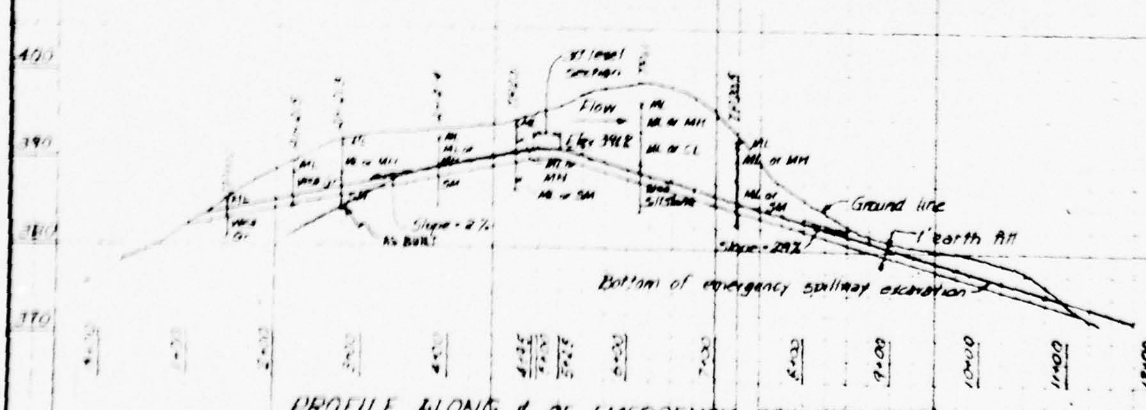


SECTION A-A

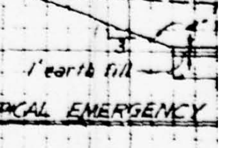
DESIGN DATA CONSTRUCTED		
	Station	Elev
Dam	1+12	40
	2+90	40
	3+65	40
	7+35	40
	9+80	40
EMS Dike	4+50	40
	4+95	40
	5+25	40
	6+75	39



PROFILE ALONG ℄ OF PRINCIPAL SPILLWAY EXCAVATION



PROFILE ALONG ℄ OF EMERGENCY SPILLWAY (EMS)



TYPICAL EMERGENCY

EARTH FILL REQUIREMENT

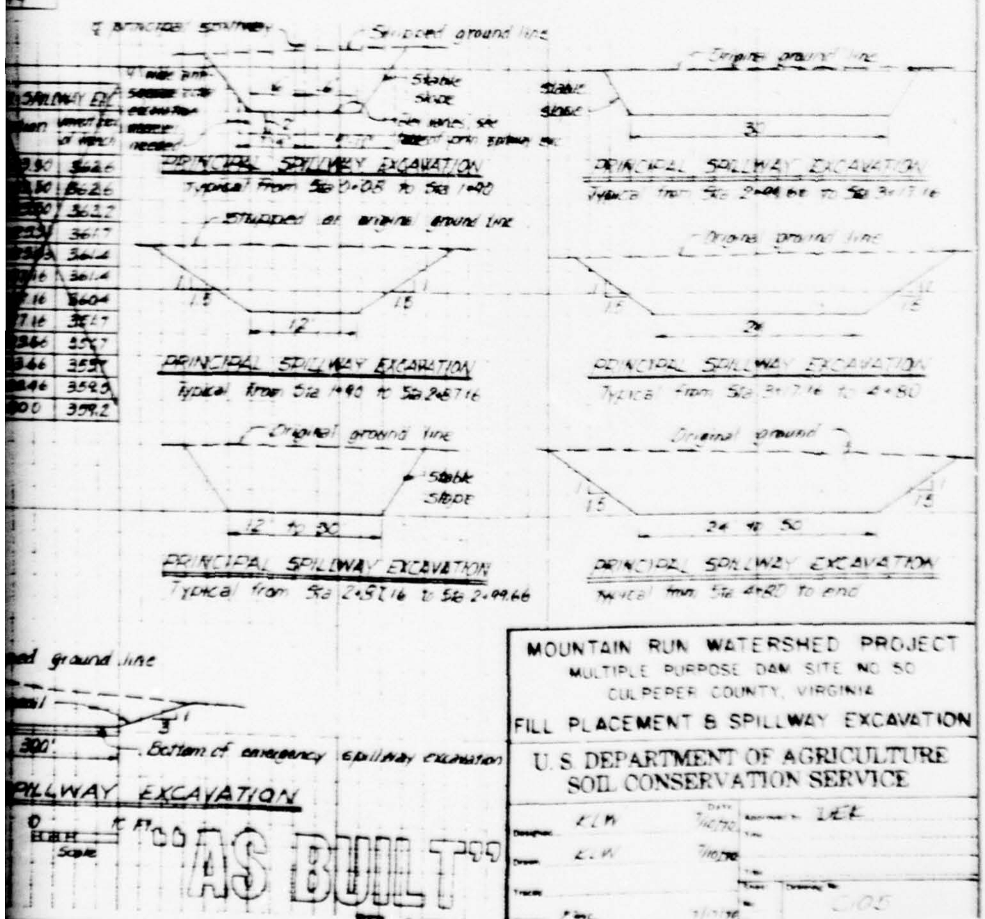
ZONE	MATERIAL					
1	Clayey silt and sandy silt (ML-MH) from EMS represented by samples 111-1, 112, and 210-A and borrow area, represented by samples 103-1, 112-1, 117-1, 154-1, 114-1, 102-1 and 171-1	[illegible]	[illegible]	Minimum water content	2	[illegible]
2	Sand and gravel (SM, GM, GP) from borrow area, represented by samples 152-2 and 104-1. Weathered siltstone from EMS, represented by sample 121-1, and weathered greenstone from borrow area and EMS, represented by sample 202-1.	16"	24"	See Spec. 23	C	See spec. 23

[1] Maximum lift thickness prior to compaction
[2] Minimum water content at time of placement

NOTES:

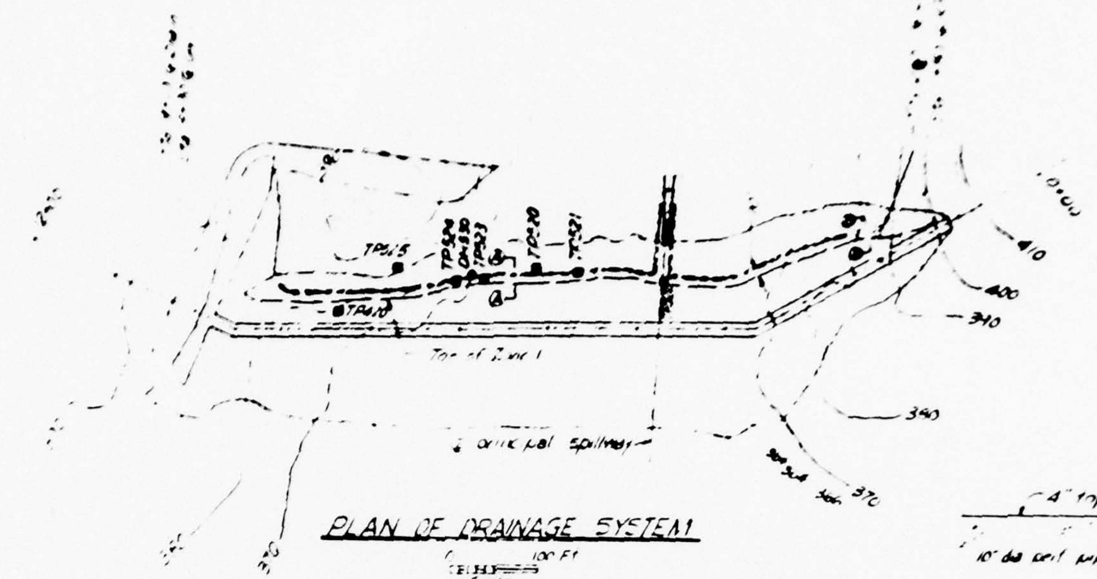
1) The foundation surface at the base of the dam [illegible] 6 inches and compacted prior to placement of fill material.
2) 24" riprap over 12" bedding to be placed according to Construction Specification [illegible] by Soil Conservation Service.
3) Abbreviations in addition to symbols in Unified Soil Classification: We = Weathered, Gr = Greenstone, Br = Breccia
4) For excavation for concrete cutoff near the riser and concrete [illegible] between principal spillway Sta 3+31 and Sta [illegible] see drawing [illegible]

Note: [illegible] of gravel placed under base of riser and outlet structure to provide [illegible] for construction.



MOUNTAIN RUN WATERSHED PROJECT
MULTIPLE PURPOSE DAM SITE NO 50
CULPEPER COUNTY, VIRGINIA
FILL PLACEMENT & SPILLWAY EXCAVATION
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE IV



PLAN OF DRAINAGE SYSTEM

0 100 Ft
Scale

SECTION CC

0 10 Ft
Scale

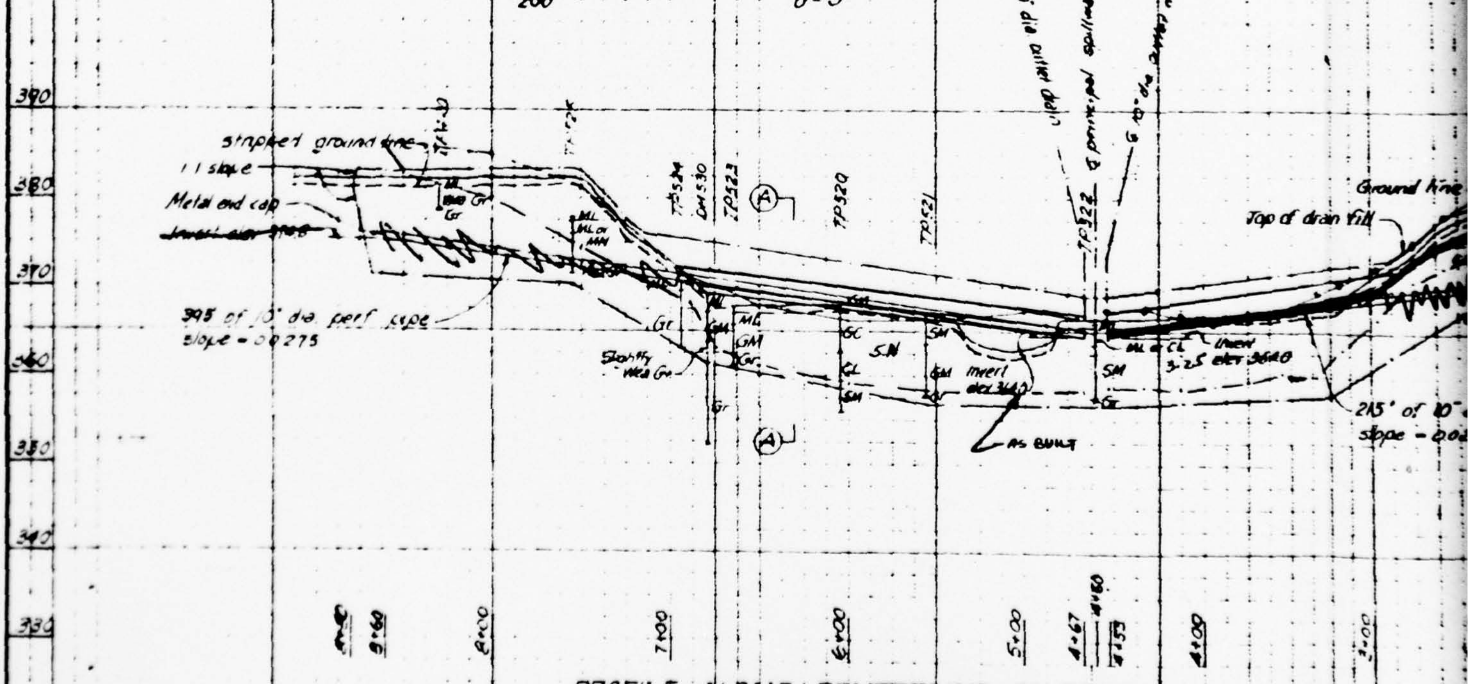
NOTES:

1. The riprap material shall conform to the following gradation limits:

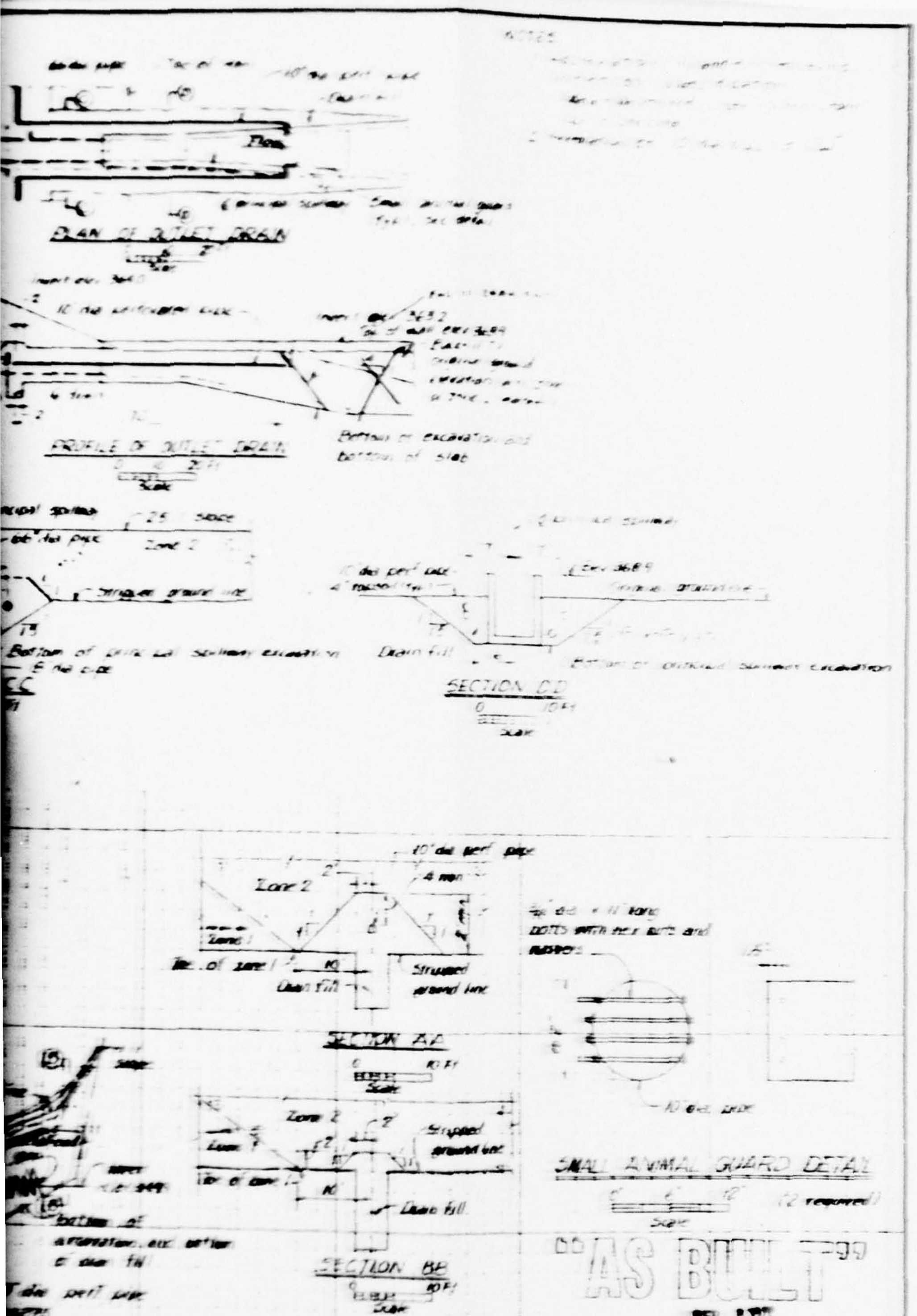
Size	Percent Smaller by Weight
24"	100
15"	50
3"	15
2"	0

2. The bedding material shall conform to the following gradation limits:

U.S. Standard Sieve Designation	Percent Passing by Weight
3"	100
2"	90 - 100
3/4"	79 - 91
3/8"	69 - 82
#4	57 - 72
#16	32 - 49
#50	4 - 18
#100	0 - 5
#200	0 - 5



PROFILE ALONG CENTERLINE OF DRAIN

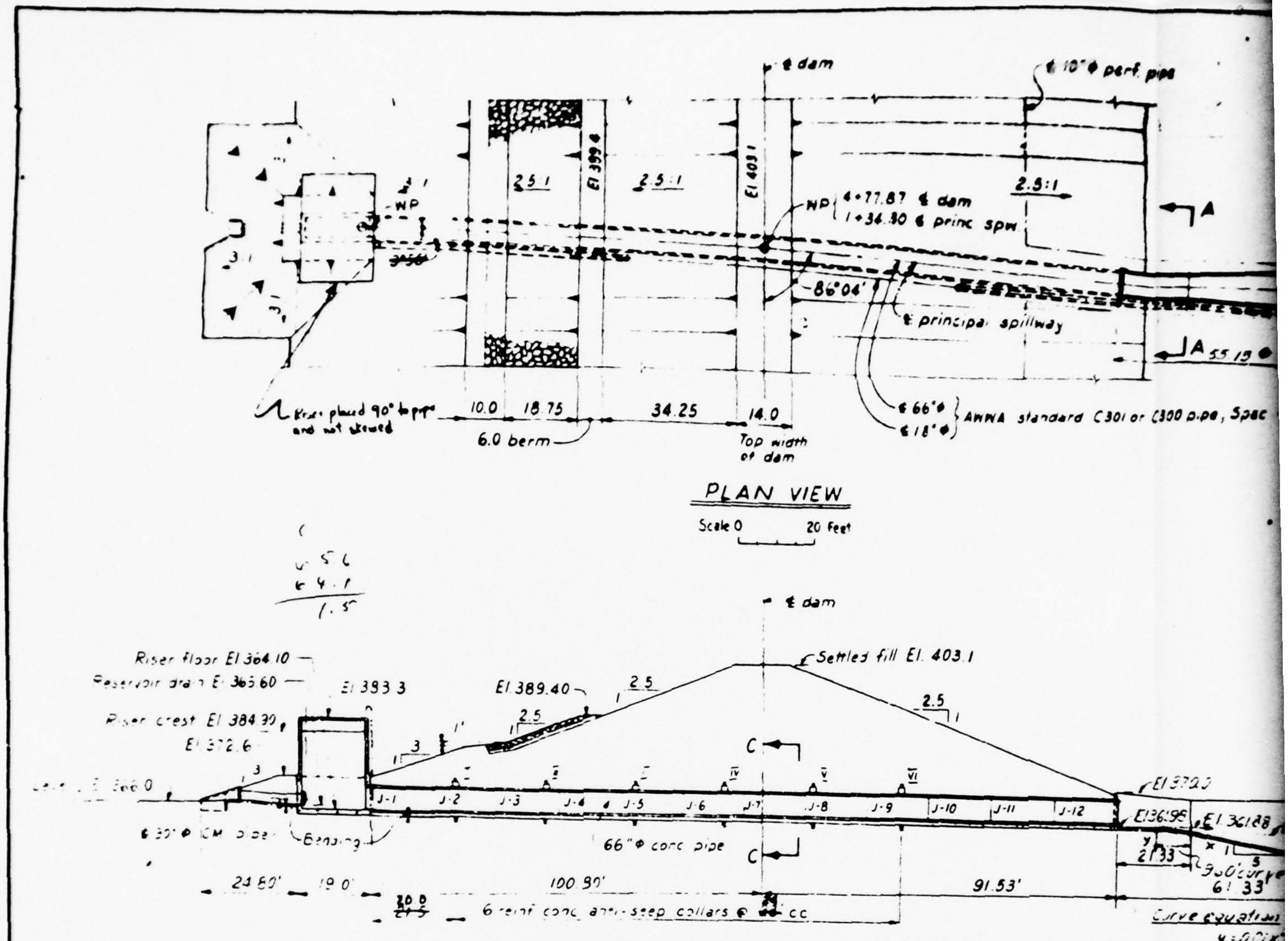


Design data for drain fill		
Sieve No.	% passing	Actual
3"	100	100
1"	90-100	97.2
3/4"	89-100	92.6
3/8"	78-93	79.3
No.4	59-79	66
No.8	42-64	53.1
No.16	24-47	36.2
No.30	7-30	17.8
No.50	0-12	7.9
No.100	0-7	4.4
No.200	0-3	1.2

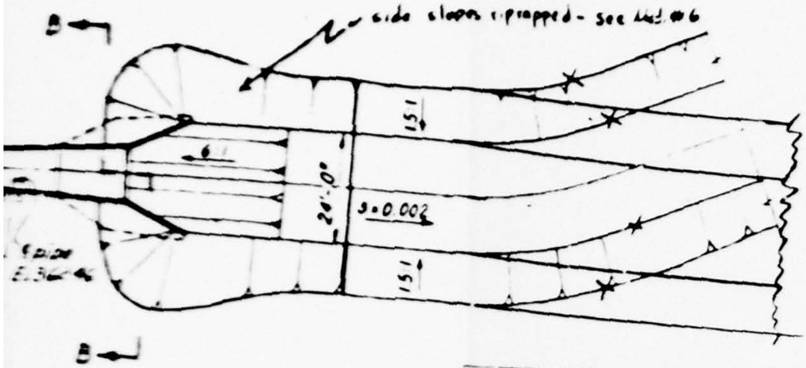
MOUNTAIN RUN WATERSHED PROJECT
MULTIPLE PURPOSE DAM SITE NO. 50
CULPEPER COUNTY, VIRGINIA
DRAINAGE DETAILS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE V



℄ dam
℄ 10" ɸ perf. pipe
2.5:1
El 399.4
El 403.1
WP
4+77.87 ℄ dam
1+34.30 ℄ princ spw
86°04'
℄ principal spillway
℄ 66" ɸ
℄ 18" ɸ
AWWA standard C301 or C300 pipe, Spec
Riser placed 90° to pipe and not skewed
10.0
18.75
34.25
14.0
6.0 berm
Top width of dam
PLAN VIEW
Scale 0 20 Feet
Riser floor El 364.10
Reservoir drain El 365.60
El 383.3
El 389.40
Settled fill El. 403.1
Riser crest El 384.30
El 372.6
66" ɸ conc pipe
Bedding
24.80'
19.0'
100.30'
91.53'
6 reinf conc anti-seep collars
El 370.0
El 361.95
El 361.88
Curve equation
PROFILE ALONG ℄ OF PRINCIPAL SPILLWAY
Scale 0 20 Feet
Sym about ℄ principal spillway
Top of wall El. 368.9
Original ground line
4" top soil
Earth fill, Zone 2
Stable slope
El 352.9
Drain fill
Water supply
10" ɸ perf pipe
12" ɸ water supply conduit
12'
SECTION A-A
SECTION B-B

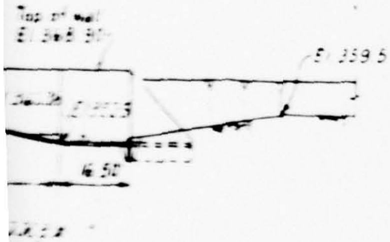


* Bedding for 18" pipe over this length to be earth bedding as shown on C118

Joint	Distance from Riser Wall	Invert of 66"φ Pipe
J-1	0.33	364.07
J-2	16.33	363.94
J-3	32.33	363.81
J-4	48.33	363.69
J-5	64.33	363.56
J-6	80.33	363.43
J-7	96.33	363.31
J-8	112.33	363.18
J-9	128.33	363.05
J-10	144.33	362.92
J-11	160.33	362.80
J-12	176.33	362.67
Outlet	192.33	362.54

Collar	Distance from Riser Wall	Invert of 66"φ Pipe
I	20.0 ~~21.5~~	363.90
II	44.0 ~~44.5~~	363.72
III	68.0 ~~67.5~~	363.53
IV	92.0 ~~90.5~~	363.35
V	116.0 ~~113.5~~	363.17
VI	140.0 ~~136.5~~	363.96

Dimensions for pipe length are based on nominal lengths and do not include creep.

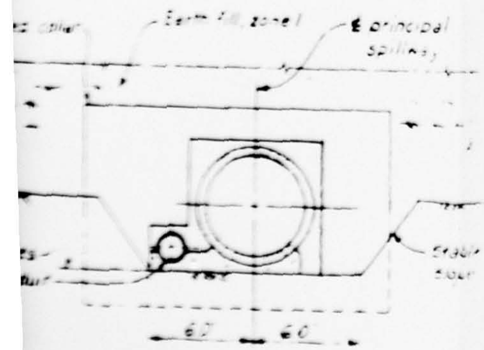


NOTES:

1. All concrete in accordance with Spec. 31
2. All steel reinforcement in accordance with Spec. 34
3. For concrete conduit details see sheet C117
4. For principal spillway details see sheets C119 and C120.

"AS BUILT"

SEP 8 1972



SECTION C-C

Scale 0 5 10 Feet

1" = 5'

Except as noted

MOUNTAIN RUN WATERSHED PROJECT

MULTIPLE PURPOSE DAM SITE NO 50

CULPEPER COUNTY, VIRGINIA

PRINCIPAL SPILLWAY

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

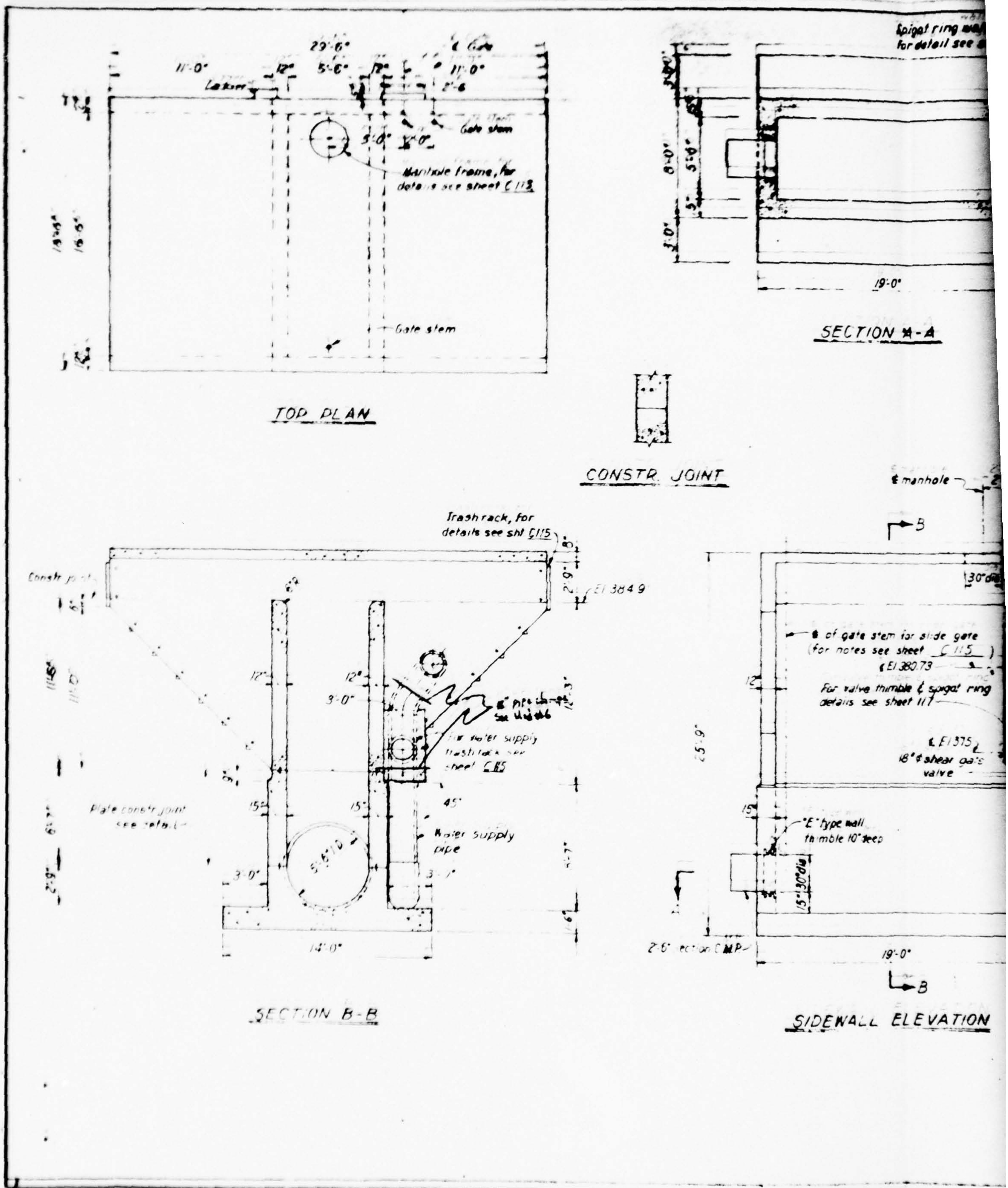
TSG

C110

2

SCS-313-Q9-64

PLATE VI


TOP PLAN
23'-6"
11'-0"
12"
5'-6"
12"
11'-0"
2'-6
℄ Gate
3'-0"
Gate stem
Manhole frame, for details see sheet C115
Gate stem
SECTION A-A
Spigot ring wall
for detail see
8'-0"
5'-6"
2'-0"
19'-0"
CONSTR. JOINT
SECTION B-B
Trash rack, for details see sht C115
El 384.9
12"
3'-0"
15"
45°
Water supply pipe
Plate constr joint see detail
5'-6" I.D.
3'-0"
14'-0"
For water supply trash rack see sheet C115
SIDEWALL ELEVATION
℄ manhole
℄ of gate stem for slide gate (for notes see sheet C115)
℄ El 380.73
For valve thimble & spigot ring details see sheet 117
℄ El 375
18" ∅ shear gate valve
"E" type wall thimble 10" deep
15"
30" dia
25'-9"
2'-6" section CMP
19'-0"
B

RISER REINF. STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
T 1	8	64	11-8	1			720-0
2	7	36	12-6	1			420-0
3	6	24	14-3	21	4-6	9-9	345-0
4	8	32	14-9	1			472-0
5	7	48	14-9	21	4-9	10-0	708-0
6	8	8	9-6	19	1-0	8-6	76-0
7	8	2	7-8	1			15-6
8	8	2	9-8	1			19-6
9	5	4	11-9	1			47-0
10	5	4	13-9	1			55-0
11	5	4	15-9	1			63-0
12	5	4	17-9	1			71-0
13	5	4	19-9	1			79-0
14	5	4	21-9	1			87-0

MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
T 15	8	4	23-9	1			95-0
16	8	4	25-9	1			103-0
17	8	4	27-9	1			111-0
18	8	16	29-3	1			468-0
19	8	8	13-6	1			108-0
20	8	8	12-6	1			100-0
21	8	8	11-6	1			92-0
22	8	8	10-5	1			84-0
23	8	8	9-6	1			76-0
24	8	8	8-6	1			68-0
25	8	8	7-6	1			60-0
26	8	8	6-6	1			52-0
27	8	8	5-6	1			44-0
28	8	12	4-6	1			54-0
29	5	8	12-0	19	3-6	8-6	96-0
30	6	72	17-6	1			1260-0
31	6	7	14-0	1			98-0
32	4	12	13-0	1			156-0
33	4	30	29-3	1			877-6
34	4	2	4-6	21	3-3	1-3	9-0
35	4	2	17-3	21	3-3	14-0	34-6
T 36	4	60	13-0	21	3-3	9-9	780-0
B 1	6	19	13-6	1			256-6
2	6	28	18-6	1			518-0
3	9	74	10-6	21	5-6	5-0	777-0
4	7	22	11-0	21	10-3	0-9	242-0
5	7	40	15-0	21	10-3	4-9	600-0
6	7	10	12-6	21	10-3	2-3	125-0
7	5	62	4-0	1			248-0
8	5	48	5-9	1			276-0
9	5	82	6-0	21	5-0	1-0	492-0
10	7	36	17-6	1			630-0
11	5	22	5-0	1			110-0
12	5	20	6-6	1			130-0
13	5	40	8-0	1			320-0
14	5	10	6-9	1			67-6
15	8	19	13-6	1			256-6
B16	9	18	8-0	1			144-0

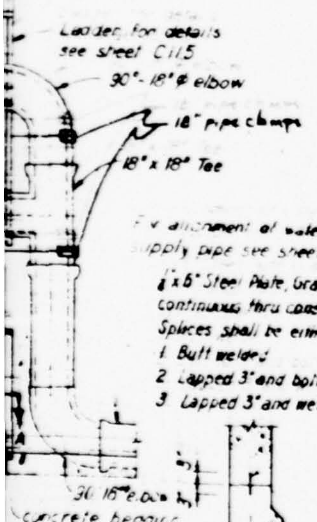
QUANTITIES

STEEL

No. 4 bars	= 1,241 lbs
No. 5 bars	= 5,173 "
No. 6 bars	= 3,717 "
No. 7 bars	= 5,570 "
No. 8 bars	= 885 "
No. 9 bars	= 3,132 lbs

CONCRETE

Class 4000 ~~[illegible]~~ 86.1 cu yds



$\frac{1}{4}$" x 6" Steel Plate, Grade B or C continuous thru constr joint
Splices shall be either
1. Butt welded
2. Lapped 3" and bolted
3. Lapped 3" and welded

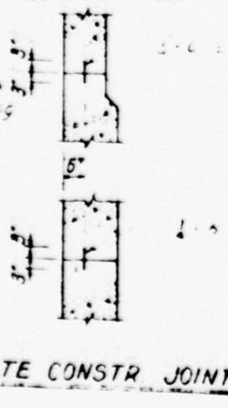
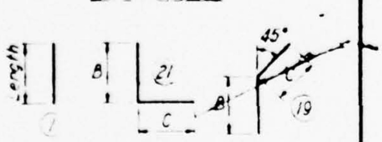


PLATE CONSTR JOINT

BAR TYPES



"AS BUILT"

Scale 0

SEP 8 1972

MOUNTAIN RUN WATERSHED PROJECT
MULTIPLE PURPOSE DAM SITE NO 50
CULPEPER COUNTY, VIRGINIA

RISER DETAILS-SHEET 1

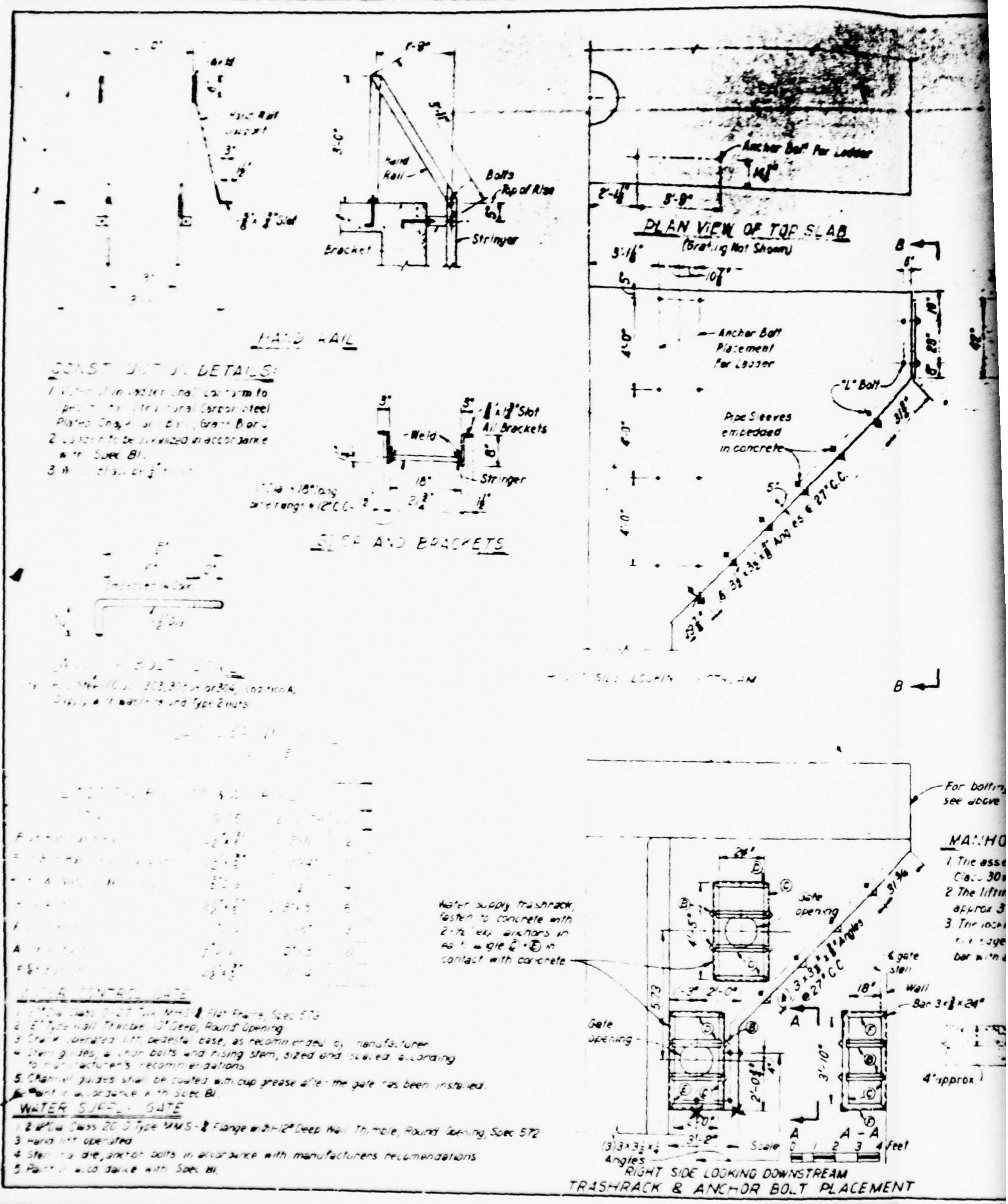
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by
Drawn W.T.		Title
Checked WHT	Sheet	Drawing No. C111

2

SCS-313-L.P. 64

PLATE VII



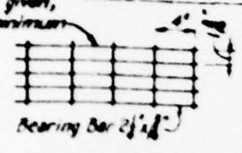
HAND RAIL
CONSTRUCTION DETAILS
SIDE AND BRACKETS
Hand Rail
Bolts
Top of Riser
Bracket
Stringer
Weld
All Brackets
PLAN VIEW OF TOP SLAB
(Grating Not Shown)
Anchor Bolt For Ladder
Anchor Bolt Placement For Ladder
"L" Bolt
Pipe Sleeves embedded in concrete
WATER CONTROL GATE
5. Channel guides shall be coated with cup grease after the gate has been installed.
WATER SUPPLY GATE
3. Hand lift operated
4. Stem guide, anchor bolts in accordance with manufacturers recomendations
Water supply trashrack, fasten to concrete with 2-½ exp. anchors in each angle in contact with concrete
Gate opening
Wall
4" approx.
For bolting see above
RIGHT SIDE LOOKING DOWNSTREAM
TRASHRACK & ANCHOR BOLT PLACEMENT

CONSTRUCTION DETAILS

1. Material in Trash Rack shall conform to Spec. 81 for Structural Carbon Steel Plates, Shapes and Bars, Grade B or C.
2. Entire Trash Rack to be galvanized in accordance with Spec. 81.

TRASH RACK BILL OF MATERIALS			
ITEM	SIZE	LENGTH	QUANTITY
Angles (A)	3½" x 3½" x ⅜"	17'-8"	~~15~~ 11
Strap	⅜" x 2" x 42"	—	4
"L" Bolt	⅝" Dia.	9" x 15"	~~34~~ 30
Grating Panel	42" x 17'-6"	—	2
Pipe Sleeves	⅞" Dia.	1'-0"	36
Angles (B)	3½" x 3½" x ⅜"	1'-11"	6
Angles (C)	3½" x 3½" x ⅜"	4'-5"	6
Angles (D)	3½" x 3½" x ⅜"	2'-4"	8
Angles (E)	3" x 3½" x ⅜"	4'-5"	2
Angles (F)	3½" x 3½" x ⅜"	2'-1"	8
Bar	3" x ⅜"	2'-0"	4

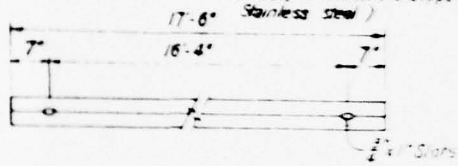
B - B



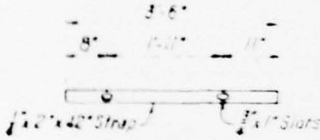
GRATING PANEL

"L" BOLT

(Supply with washers & Type 2 nuts Stainless steel)



ANGLE (A)



STRAP

TRASH RACK DETAILS

0 1 2 3 Feet

Scale

... and strapping

...LE ASSEMBLY

...mbly shall be Grey Iron Casting,
...with a 30" Dia opening
...g device shall consist of a 1" Dia. hole
...from the nuts on perimeter of the lid
...g device shall consist of a hook at
...of the lid underside and a rotating
...bolt at the opposite edge

"AS BUILT"

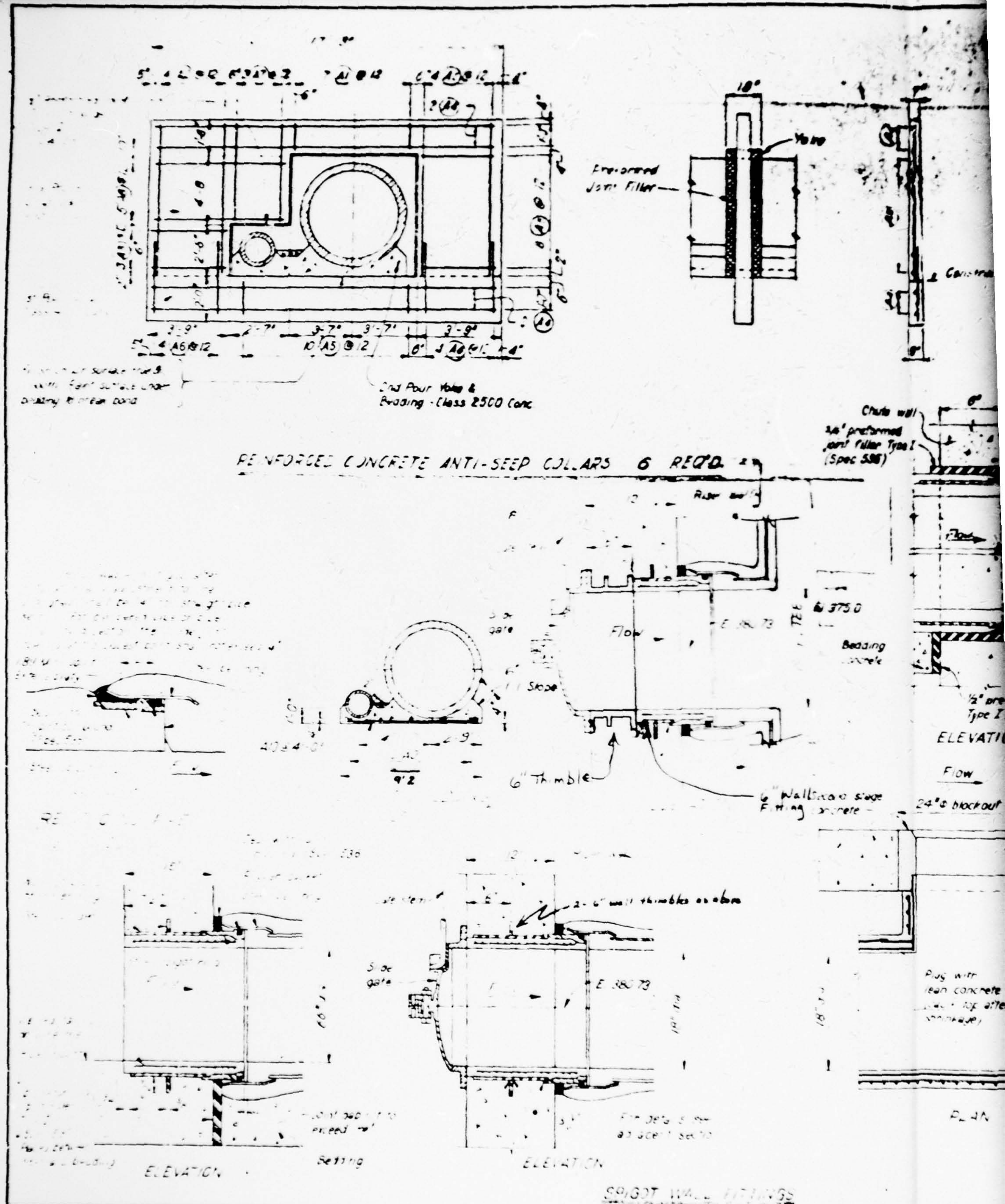
SEP 1972

MOUNTAIN RUN WATERSHED PROJECT
MULTIPLE PURPOSE DAM SITE NO 50
CULPEPER COUNTY, VIRGINIA
TRASH RACK & LADDER DETAILS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

2

PLATE VIII


REINFORCED CONCRETE ANTI-SEEP COLLARS 6 REQ'D.
Preformed Joint Filler
Yoke
2nd Pour Yoke & Bedding - Class 2500 Conc
Chute wall
3/4" preformed joint filler Type I (Spec 536)
Riser wall
Slide gate
Flow
El. 375.0
Bedding concrete
1:1 Slope
6" Thimble
6" Wall Stand slide Fitting concrete
ELEVATI
24"⌀ blockout
2-6" wall thimbles as above
Slide gate
El. 380.73
Plug with lean concrete
ELEVATION
Setting
ELEVATION
PLAN
SPIGOT WALL FITTINGS

BAR TYPE

[Length] ①

[illegible]	[illegible]	[illegible]	Type	[illegible]	[illegible]	Total Length
[illegible]	4	7'-0"	1	9	[illegible]	52'-0"
[illegible]	4	8'-0"	1	[illegible]	[illegible]	400'-0"
[illegible]	4	8'-0"	1	11	[illegible]	2[illegible]'-0"
[illegible]	4	[illegible]	1	4	[illegible]	400'-0"
[illegible]	4	1'-0"	1	19	[illegible]	90'-0"
[illegible]	4	8'-0"	1	[illegible]	[illegible]	93'-0"
[illegible]	4	6'-0"	1	[illegible]	[illegible]	105'-0"
[illegible]	4	[illegible]	1	6	30	175'-0"
[illegible]	4	2[illegible]'-0"	1	—	45	[illegible]'-0"
[illegible]	4	1'-0"	1	—	48	412'-0"

QUANTITIES (This sheet only)

STEEL.

No 4 bars 2047.4 = 2036 lbs

CONCRETE

Class 4000 191 Cu Yds

Class 2500 ~~[illegible]~~ Cu Yds

49.9

NOTES:

1. 66" Inside diameter reinforced concrete conduit - Spec 41
   a. Twelve 16'-0" Sections = 192 Ft.

      One spigot wall fitting
   b. Total vertical load on conduit = 44,700 lb/ft based on O.D. = 6.48 Ft.
   c. Min. 3 edge bearing strength.
      Non prestressed pipe, 0.01 "crack" (AWWA C-300) = 18,700 lb/l.f.
      Prestressed pipe, 0.001 "crack" (AWWA C-301) = 14,000 lb/l.f.
   d. Pressure head = 28.85 Ft.

2. 18" Inside diameter reinforced concrete conduit - Spec 41
   a. Fifteen [illegible] section = 24[illegible]
      One 6.36 section
      Two Elbows (18"Ø × 90°)
      Two Tees 8"Ø × 18"Ø
      One bend 18"Ø × 3[illegible]°30'
      One spigot wall fitting
      ~~[illegible]~~

   c. Min. [illegible]
      [illegible]
   d. [illegible] head [illegible] Ft.

"AS BUILT"

SEP 8 1977

NOT TO SCALE

MOUNTAIN RUN WATERSHED PROJECT
MULTIPLE PURPOSE DAM SITE NO 50
CULPEPER COUNTY, VIRGINIA
CONDUIT DETAILS

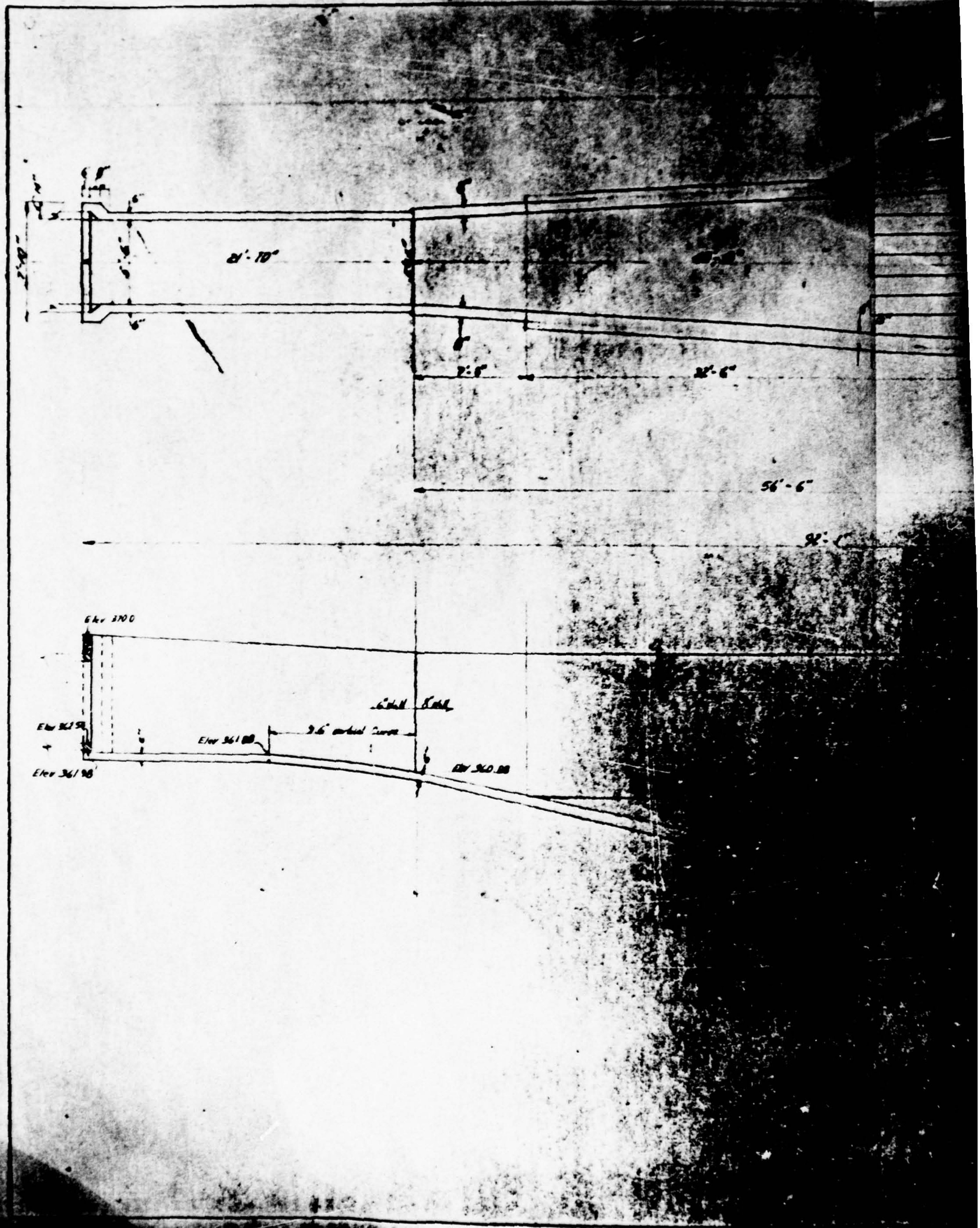
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FB

C117

2

[redacted] PLATE IX



21'-10"
7'-6"
32'-6"
56'-6"
Elev 370.0
9.6' vertical curve
Elev 361.88
Elev 360.88
Elev 361.98'

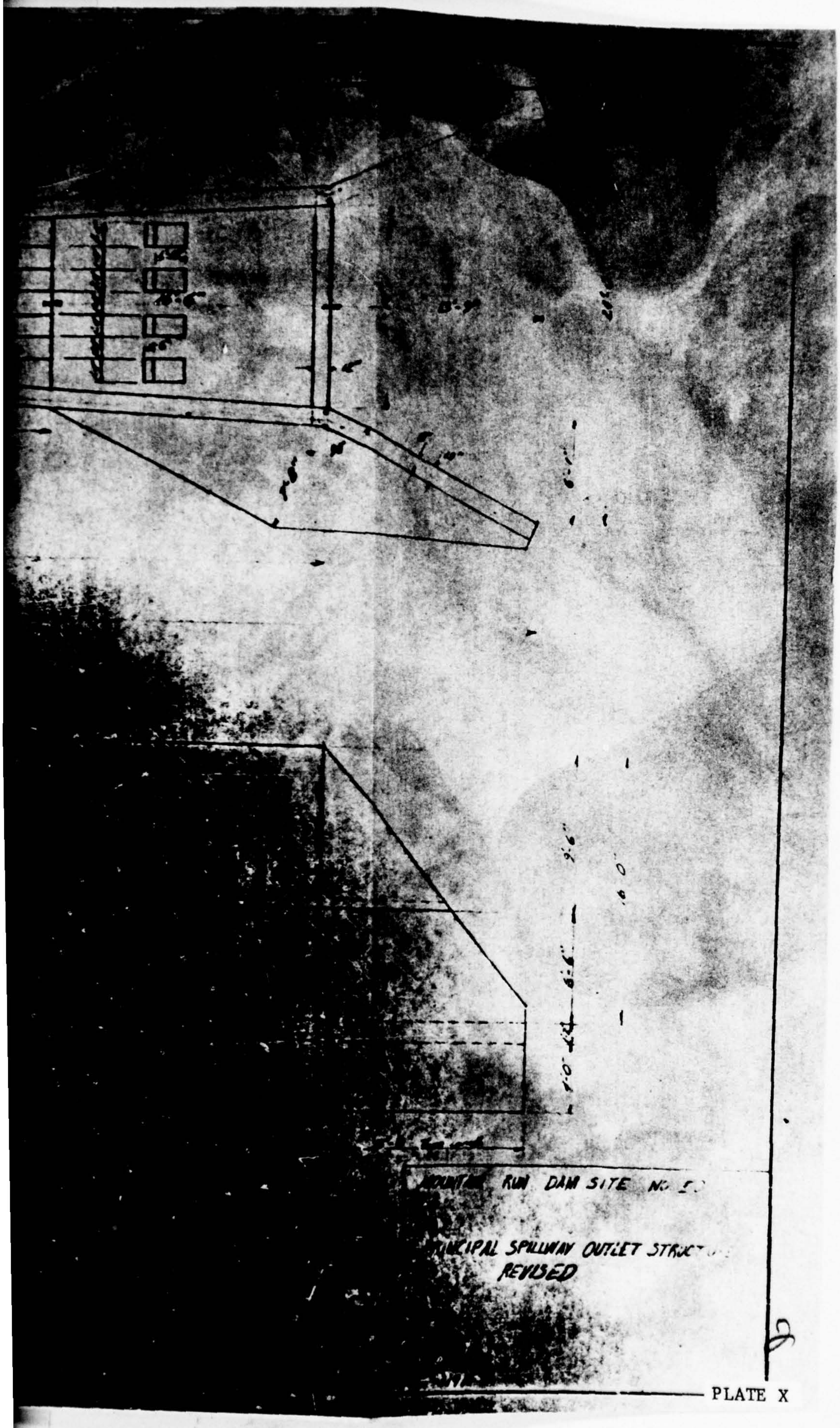


PLATE X

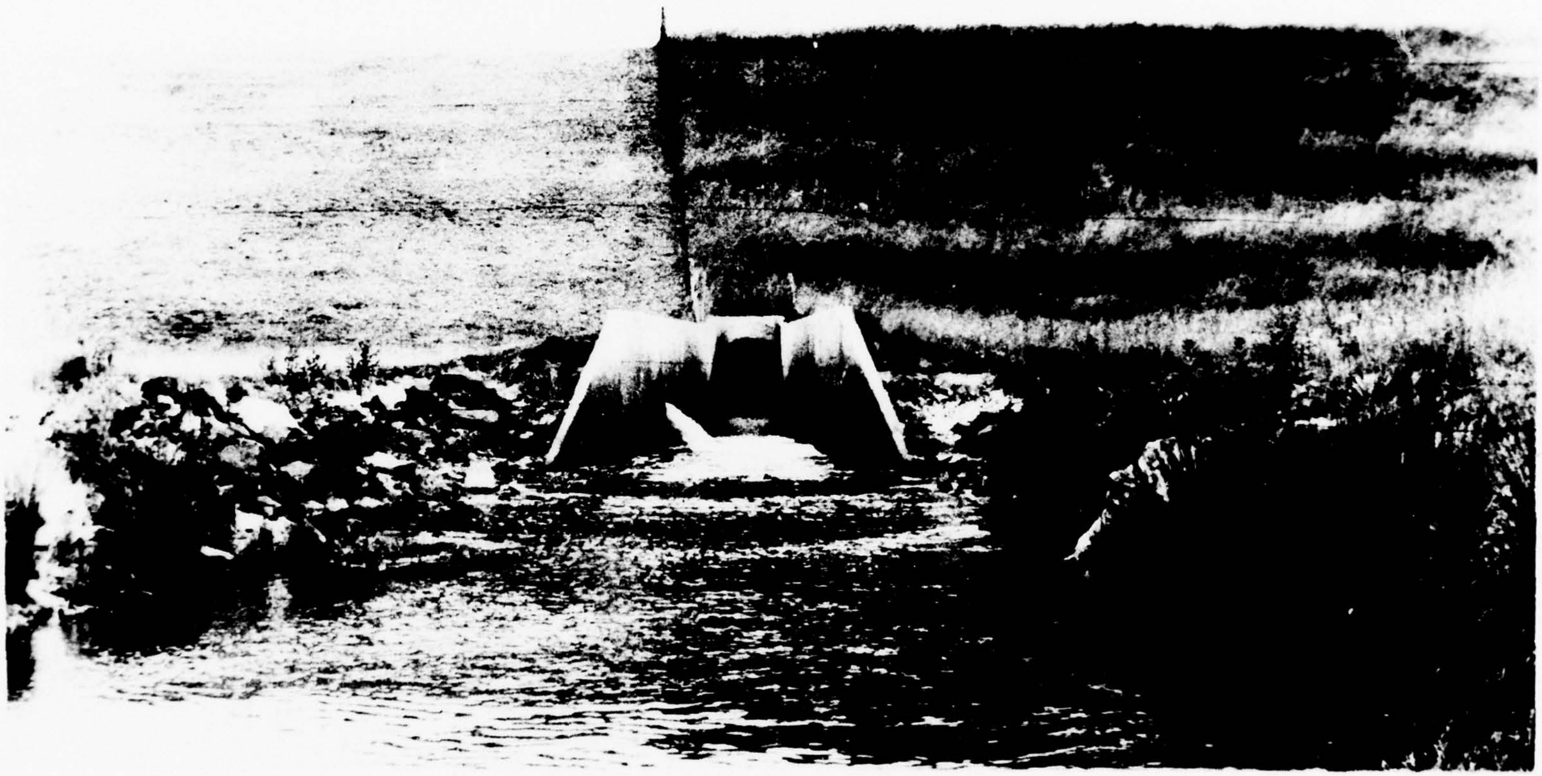
APPENDIX II

PHOTOGRAPHS

UPSTREAM

VIEW LOOKING UP EMERGENCY SPILLWAY FROM DOWNSTREAM AREA

DROP-INLET STRUCTURE



OUTLET WORKS

DOWNSTREAM

APPENDIX III

FIELD OBSERVATIONS

Name of Dam: Mountain Run Dam No. 50
County: Culpeper State: Virginia
Coordinates: Lat. 38° 27.8' Long. 78° 02.3'
Date of Inspection: 7 June 1978
Weather: Overcast - Temperature: 75°F
Pool Elevation at Time of Inspection: 385' m.s.l.
Tailwater at Time of Inspection: 362' m.s.l.

Inspection Personnel:

Soil Conservation Service
Bill Adams, District Engineer
Bill Bell
James F. Blodgett, Area Engineer
Charles McDowell, Asst State Engr

State Water Control Board
H. Wigglesworth

Corps of Engineers
W. Barker
R. Cheng
L. Jones
D. Pezza (recorder)
J. Robinson
K. Brooker

1. Embankment:

1.1 Surface Cracks: The slopes, crest, and abutment contacts were inspected. A fence traversed the dam running from upstream riprap to the stilling basin. The dam is covered with tall kentucky-fescue 31 grass. Grass left of the outlet works is 3 to 4 feet high except for the toe where it was recently mowed to about 4 inches. The vegetation made observations difficult. The portion of the dam right of the fence is within a golf course. The grass is kept trimmed to approximately 1.5 inches on the downstream slope and crest of dam. Soil conditions were dry and shrinkage cracks were noted in the soil. No other cracks were noted.

1.2 Unusual Movement: No unusual movement was noted on the dam. Again, vegetation inhibited observations.

1.3 Sloughing and erosion:

No sloughing or erosion was noted. Past erosion has occurred at a small portion of the toe of the dam. Remedial efforts have been performed and the area is monitored by SCS and town official for any future erosional development.

1.4 Alignment: The vertical and horizontal alignment of the dam did not deviate from the as-built drawings.

1.5 Riprap: The upstream slope, portions of the downstream area, and the area of the toe are protected against erosion with diabase rock. Riprap on the upstream slope and at the toe was in excellent condition. Light vegetation was growing in the upstream slope, but it is regularly removed by town officials. The riprap in the downstream was in a disaray and is discussed in Section 2.3, Appendix III.

1.6 Junctions: The conditions appeared good. Observations were difficult due to high vegatative growth.

1.7 Seepage: No seepage was noted. A subdrain system was installed at the base of the downstream right abutment in 1974. A 6-inch corrugated metal pipe serves the field discharging into the downstream channel. Flow was clean and less than 1 GPM. Another 6-inch corrugated metal pipe was located downstream, but is orientation was undetermined. No other seepage was noted on the slopes, at the abutments, along the toe or along conduits passing through the dam. Swamp-like vegetation exists about 150 feet downstream of the dam. This is a natural condition that existed prior to construction of the dam.

1.8 Drains:

Two 6-inch corrugated metal pipes serve the foundation drain. Both discharge into the stilling basin. Flow was minimal and appeared to be colored. The basin walls were stained yellow-brown.

1.9 Instrumentation: There were no instrumentation or staff gages for the entire dam.

2. WATERWORKS:

2.1 Intake Structure: There was no access to the riser. The structure is concrete and showed no apparent deterioration. Two vertical shafts, without manual controls for regulation of intake valves, extended above the riser. The regulating works were not operated during the inspection. Openings to the riser are protected with a trash rack. No debris was lodged in the immediate area. The structure had a safety ladder, but a manhole cover was missing. The pool elevation was about 3 feet below the top of the riser.

2.2 Outlet Works: The 66-inch ungated concrete conduit serves as the spillway running from the riser through the dam. The conduit was passing very little flow. The spillway discharges into a Saint Anthony Falls concrete stilling basin. The concrete structure has some deterioration. There are intermittent cracks along vertical construction joints. The downstream end of the left wall has diagonal cracking. Spalling has occurred around an 18-inch pipe discharging flow for water supply needs, and around the spillway outlet. There is evidence of cosmetic repair in both these areas, which has also deteriorated. The tailwater elevation was about 2 feet below the invert of the 18-inch discharge pipe.

2.3 Outlet Channel: The stilling basin serves as the discharge channel. The downstream channel is riprap, which extends from behind the stilling basin to approximately 50 feet downstream. The riprap has eroded away in the area behind the stilling basin. The downstream channel protection has experienced settling and has vegetation growing in it. The stream is about 2 feet deep.

3. EMERGENCY SPILLWAY: Most of the spillway is covered with 3 to 4 feet of grass. Portions of the spillway have recently been trimmed to approximately 6 inches. The spillway appeared in good condition.

4. RESERVOIR: The area surrounding the upstream reservoir consists of gentle rolling hills covered with pasture land or woods. No observations of sediment could be made. The water was turbid and some debrid was evident. Town officials regularly remove debris.

5. DOWNSTREAM CHANNEL: The streambed broadens to 20 to 30 feet and averages 5 feet in depths. A fence crosses the stream 0.4 miles downstream of the dam and has debris damming against the fence. The surrounding flood plain is relatively flat. The area right of the stream is a golf course. There are numberous houses that border the stream about a mile downstream.

APPENDIX IV - GEOLOGY REPORT

Form SCS VA-67
Sheet 1 of ______

12-65

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Sheet 1 of 15
VA 585-G

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Virginia County Culpeper ; -- ¼, -- ¼, Sec. --, T -- R -- ; Watershed Mountain Run

Subwatershed -- Fund class FP-2 (FP-2, WP-1, etc.) Site number 50 Site group I Structure class C

Investigated by T. Mack, Geologist (signature and title) Equipment used Ford 753 Backhoe Sprague Henwood 40C Drill Date 9/69

SITE DATA

Drainage area size 9.82 sq. mi. 6,285 acres. Type of structure Earthfill Purpose Water Supply & Flood Prevention

Direction of valley trend (downstream) east Maximum height of fill 35.6 feet. Length of fill 909 feet

Estimated volume of compacted fill required 110,000 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	942	164	17.0
Floodwater	2,095	402	26.2
water supply	1,000	254	17.0

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Piedmont Province Topography rolling Attitude of Triassic beds: Dip 29° E Strike N 45° E

Steepness of abutments: Left 09 percent; Right 20 percent. Width of floodplain at centerline of dam 370 feet

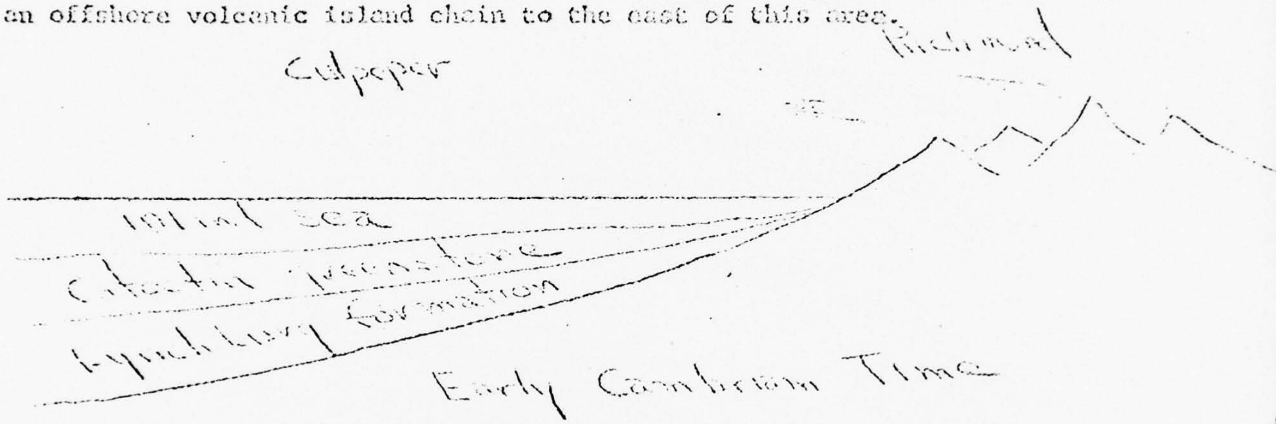
General geology of site: Mountain Run No. 50 is located approximately one mile west of the Culpeper County Court House building in Culpeper, Virginia.

This site is located on the border between the older Paleozoic - Precambrian metamorphic rocks and the sediments of the Culpeper Triassic Basin. The contact between the Triassic basin sediments and the older metamorphic rocks is a thrust fault that has been offset by later transverse faults.

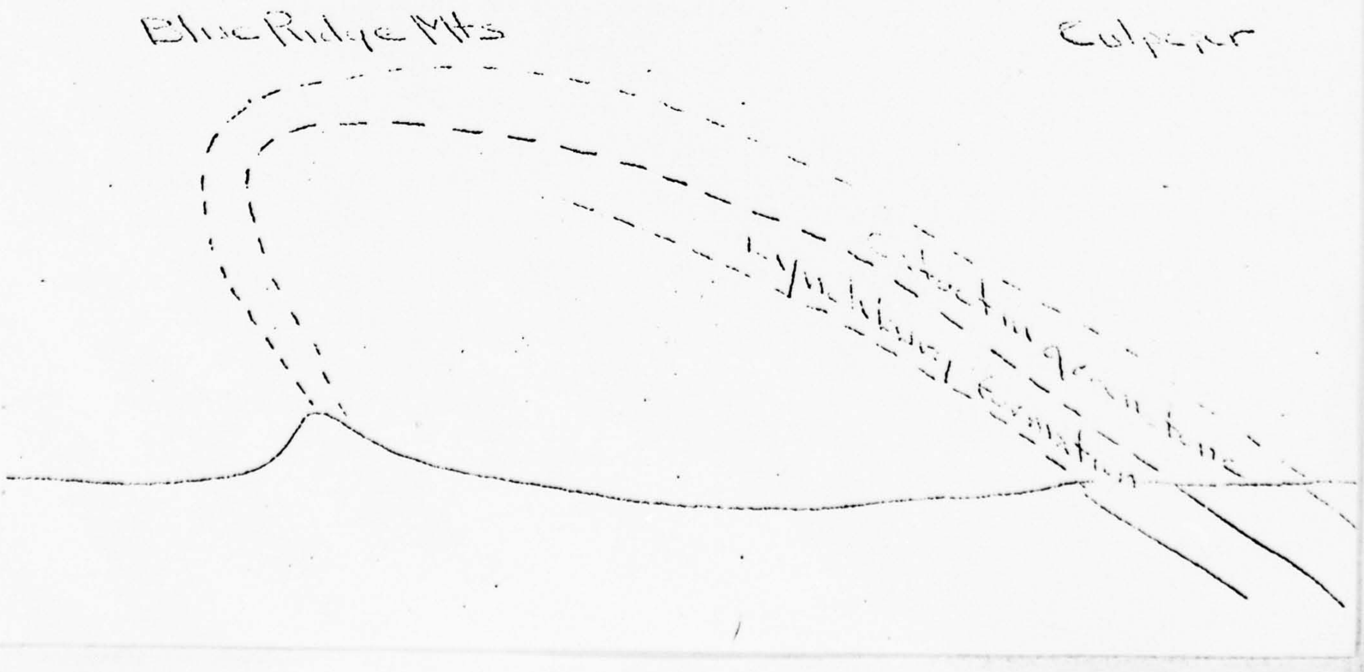
Catoctin greenstone and Lynchburg mica schist are the formations present in the older metamorphic rock area. Of these the Catoctin greenstone is the younger formation. This formation was deposited in late Precambrian to early Cambrian time. The rock is metamorphosed basic lava that has advanced to greenschist metamorphic facies. This greenschist facies intensity has metamorphosed the basic lava into the minerals epidote,

feldspar, hornblende, chlorite, quartz, and some copper sulfides. In this area the Catoctin greenstone is considered to be 13,000 feet thick.

Interspersed within the epidote hornblende greenstone are areas of high chlorite greenstone. Purple phyllite also occurs in the Catoctin greenstone. This phyllite is the greenschist facies metamorphism of an acid lava. The high chlorite greenstone and chlorite has been metamorphosed from a shale sediment to schist or phyllite by greenschist facies metamorphism. The Lynchburg formation is considered to be 9,000 feet thick. Both the Catoctin greenstone and the Lynchburg formation were deposited from an offshore volcanic island chain to the east of this area.



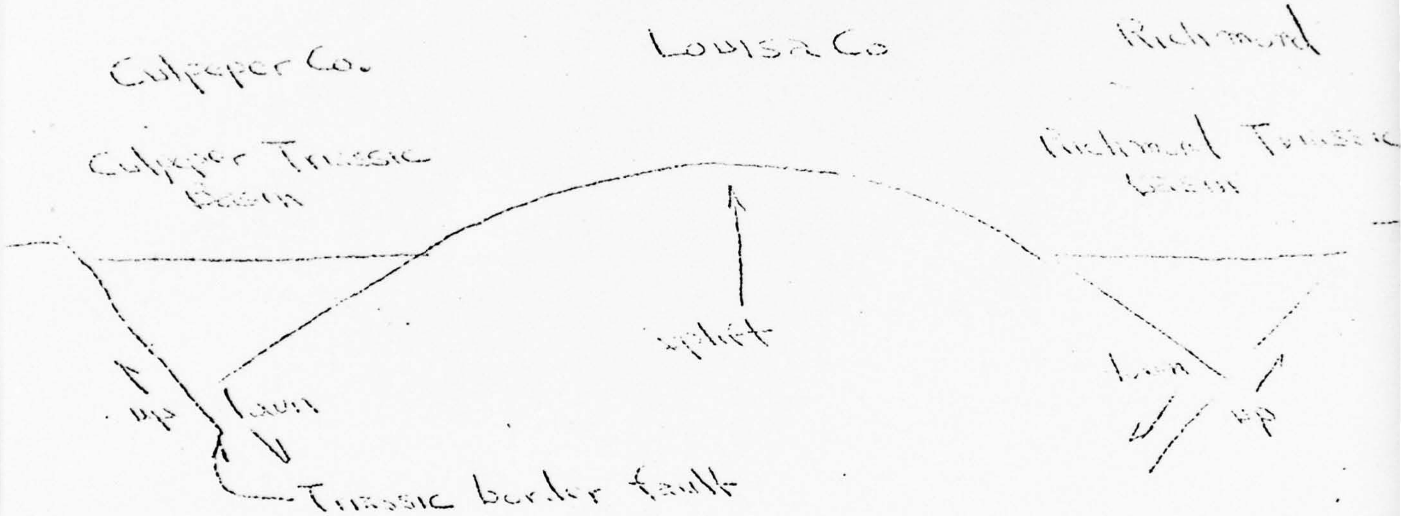
The major structure present in these metamorphic formations here is a large overturned anticlinorium. The eastern leg of this anticlinorium occurs near Culpeper. Site No. 50 is located in lower Catoctin greenstone which lies above the top of the Lynchburg schist. The western leg of the anticlinorium is present on the Blue Ridge Mountains 23 miles to the west of Culpeper.



The older Lynchburg formation occurs to the west of the Catoctin greenstone at site No. 50. This is to be expected as older formations are centrally located in an anticlinorium. However, within this larger anticlinorium are anticlinal folds that are generally overturned or even recumbent. This folding with subsequent land beveling causes an interspersing of the Catoctin greenstone and the Lynchburg schist and phyllite in complex structures.

Over these older metamorphic rocks sediments of Triassic age were deposited. These sediments are in a basin that is called locally the Culpeper Triassic basin or nationally the New York-Virginia Triassic basin. This Triassic basin extends from the Palisades of New York to northern Albermarle County, Virginia.

This Triassic age basin is the result of a rift valley caused by uplift to the east (compression) causing tension in the Culpeper basin area. This formed a rift valley with terrestial and lacustrine sediment deposited in this basin.



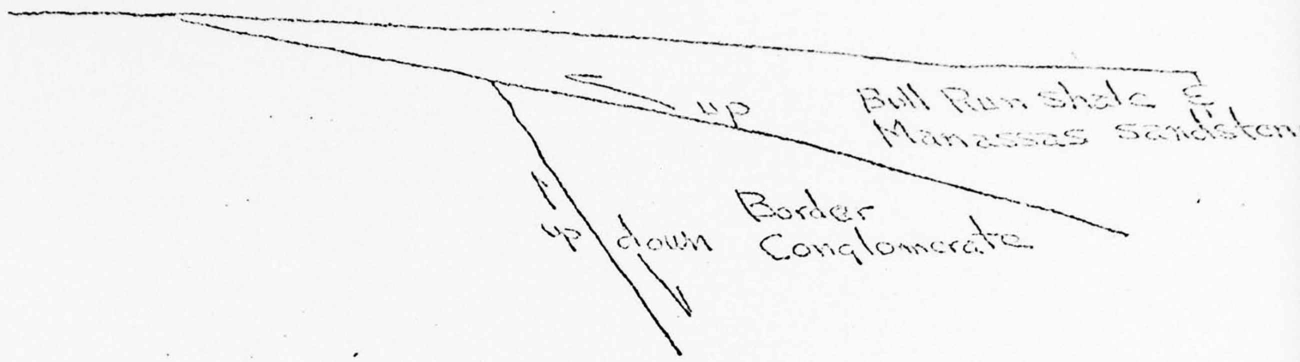
Modern examples of rift valleys are the rift valleys and fresh water lakes of central and northern Africa.

Formations present in the Culpeper basin are the Manassas sandstone, the Bull Run shale, the Border Conglomerate, and basic dikes and flows.

The Manassas sandstone is a light brown gray to brown fairly clean indurated sandstone. The Bull Run shale is an Indian red soft shale or siltstone. The Border Conglomerate has greenstone and granite cobbles and gravels in a matrix of red siltstone with calcite.

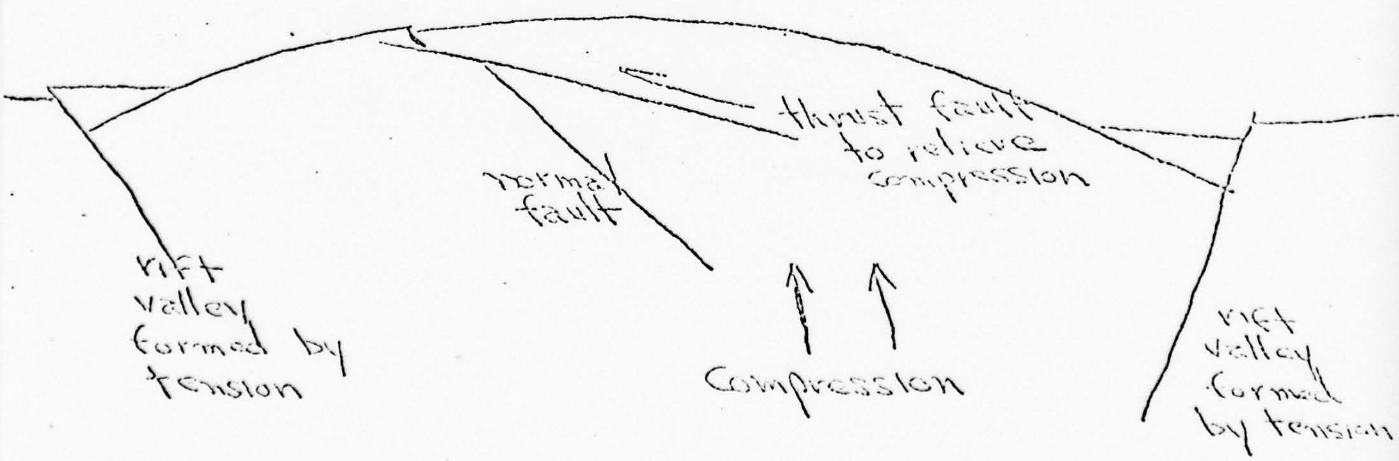
Generally the Border Conglomerate occurs near the western edge of the Triassic basin but at Site No. 50 the Manassas sandstone and the Bull Run shale occur on the

western border of the Triassic sediments. This is due to the thrust faulting present here which is assumed to have thrust the shale and sandstone over the Border Conglomerate.



Previously it was thought that the western edge of the Culpeper basin was a normal fault. (Roberts 1928). But drilling evidence shows that it is logical to assume that thrusts are present.

An explanation for this is that there were several rift valleys present in Virginia. This placed the outer tension areas under the central compression area. The fact that there are Triassic basins occurring between the two outer tension basins (Culpeper basin and Richmond basin) show an area of multiple compression strains. Among these smaller Triassic basins not in strike with the two larger basins are the Farmville, Keysvilie and Scottsville Triassic basins. Areas of multiple tension are normal for the formation of taphrogeosynclines.

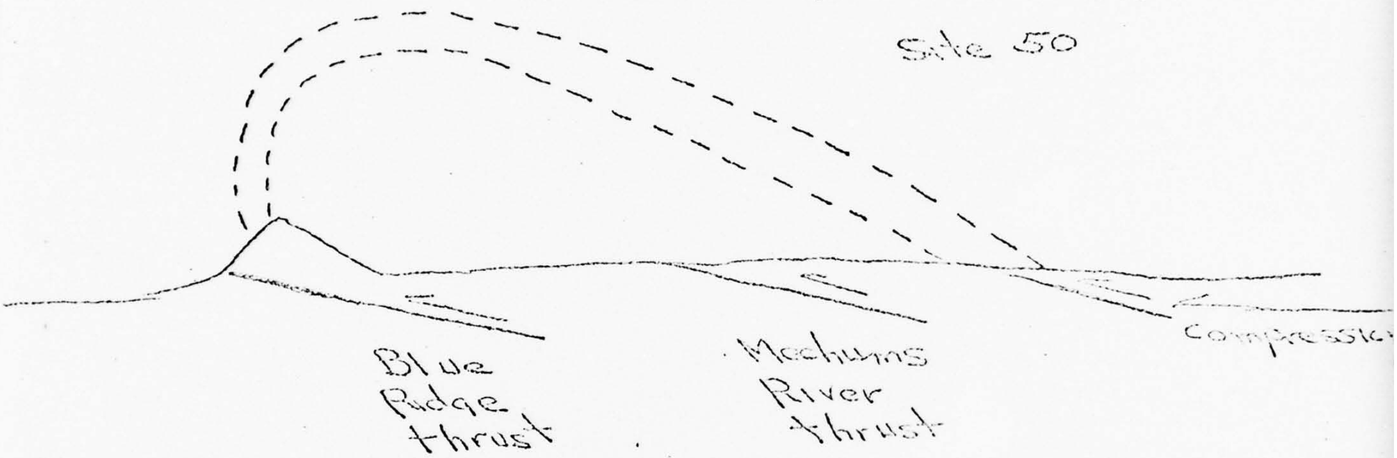


Thus the area under Site No. 50 was first subjected to tension with sediments forming in the rift to complete the taphrogeosyncline. Later this area was subjected to compression as other rifts were formed on either side of the Culpeper Triassic basin.

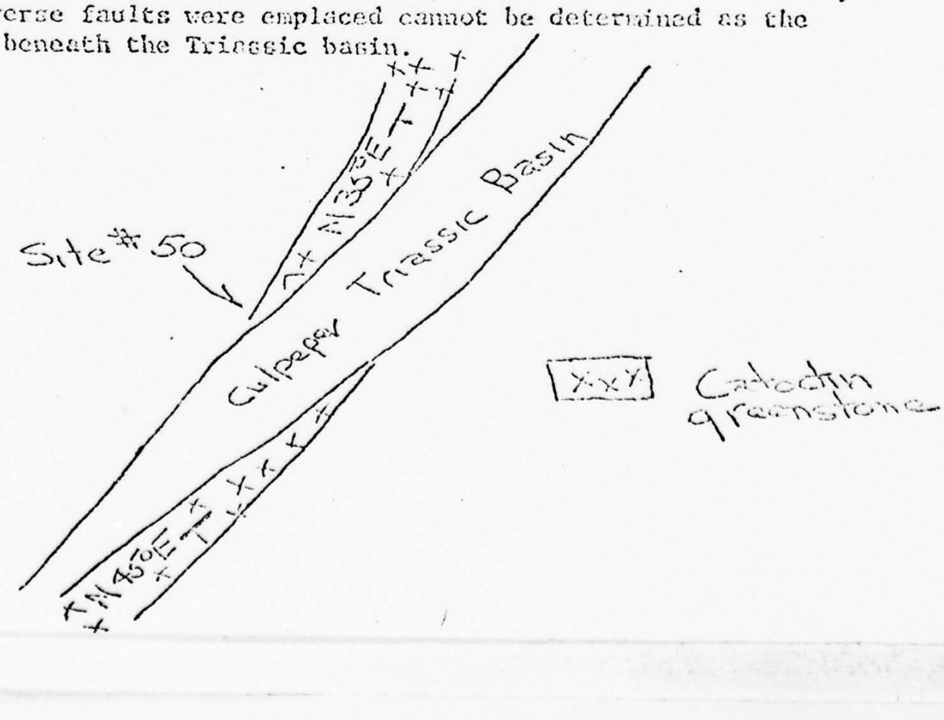
As stated above there are four factors that have caused faulting at this site.

These are listed as:

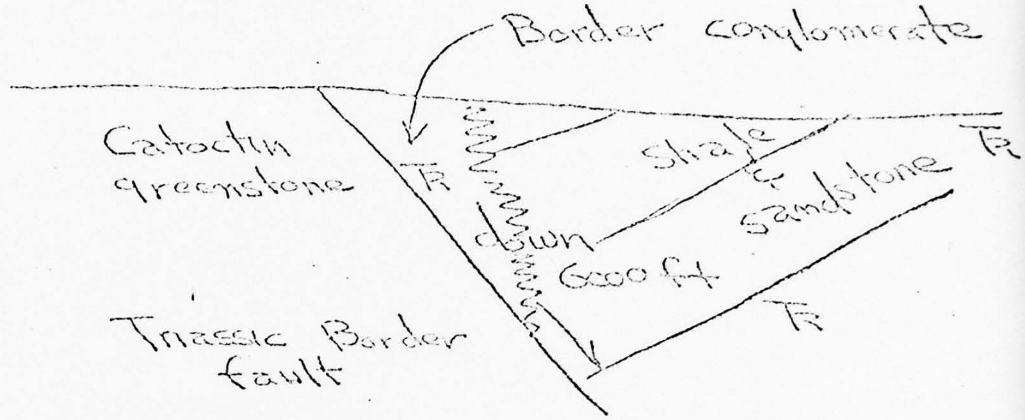
1. The folding of the Catoctin greenstone into the great anticlinorium. This could cause thrust faults to occur as compression was involved.



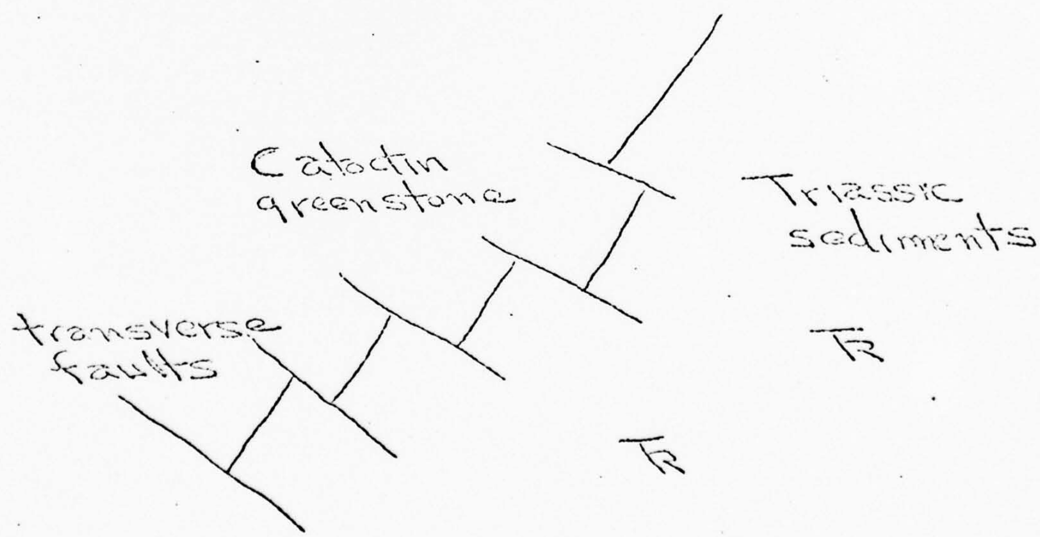
2. The bending of the Catoctin greenstone to change its strike from N 45° E to N 35° E. The former strike occurs to the southeast of Culpeper on the southern side of the Culpeper Triassic basin. Exactly how the transverse faults were emplaced cannot be determined as the hinge area is beneath the Triassic basin.



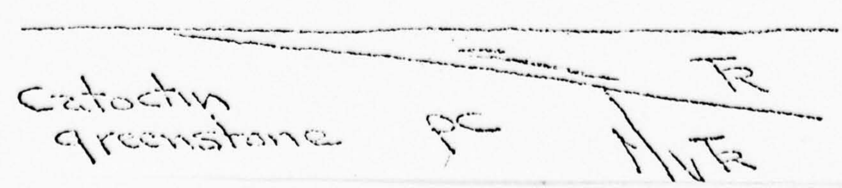
3. The tension faulting caused by the emplacement of the Culpeper Triassic basin. It was formerly considered that the Culpeper basin was bordered on the west by a normal fault. This large normal fault was called the Triassic border fault by Stose (1927) who considered this fault to have a displacement of 6,000 feet.



In Culpeper County the position of the border fault is considered to the east of Site No. 50. It is between the border conglomerate and the shale and sandstone. Thus the Triassic border fault is overridden by thrusts displacing Bull Run shale and Manassas siltstone. Tension present has caused transverse faults. These transverse faults displace the border normal fault or the thrust present.



4. Lastly, the thrust faulting of the Triassic sediments over the older metamorphic rocks. This was caused by compression in an area that was first under tension.



It can be seen from the geologic map (Sheet 2) and cross sections that the faulting under Site No. 50 is extremely complicated. The interpretation of the faulting on the geologic map is most probably incorrect. However, the faulting is so intense and diversified that a satisfactory interpretation cannot be given.

Three thrust faults are thought to be present. The upper of these thrusts Manassas sandstone and Bull Run shale over Catoctin greenstone. The lower two faults thrust greenstone over greenstone and meta-arkose. The upper fault must have been implaced after the Culpeper basin was formed. The lower faults may have been implaced in post-Manassas time also.

Soils present on Site No. 50 are complex. They range from modern alluvium and bench soil to residual soil from sandstone, siltstone, greenstone, and mica schist.

The stream pattern is strongly entrenched dendritic. The sides of the valleys range from fairly steep rockland slopes to gentle residual soil slopes.

Methods and Procedures

1. Standard penetration resistance tests were conducted in the drill holes.

Blow count was taken with the standard 140 pound hammer, 30 inch drop and 2 inch sampler.

Blow count was also taken on the drive pipe emplaced with a 300 pound hammer and a 24 inch drop. The ID of the drive pipe is 3 3/4 inches, the OD is 4 1/4 inches, and the OD of the coupling is 5 inches.

This casing blow count was converted to standard by the formula

$$N_{std} = \frac{.0005\,NE}{OD^2_{cas} - ID^2_{cas} + Q\left(\frac{OD^2_{coup} - OD^2_{cas}}{2}\right)}$$

N - number blows
E - energy - (weight pounds) inch drop
ID - inside diameter
OD - outside diameter
Q - number of couplings

The number 2 represents a factor for the average disturbance of the soil. This would be smaller in sandy alluvium and larger in hard residual soil.

Standard penetration resistance was taken at five foot intervals. Correlation between standard reading and converted casing penetration readings were fair.

2. Constant head permeability tests were measured at the end of each drill run in both soil and rocks. To obtain the correct gpm value for a drill run, the measured gpm value for that run had to be subtracted from the previous run. This is given in the chart as the actual gpm and the subtracted gpm value for the run.

The formula for k used where an open run of hole was tested is

$$k = Cp \frac{Q}{h}$$

Cp is the factor for the diameter and length of the cylinder tested as listed in the Earth Manual, page 545.

Q is the water loss in gpm

h is the height of the top of casing above the center of the area tested or the depth to the water table if this is above the tested area.

In a few cases the constant head permeability test was made through the end of the casing. Here the formula for k is:

$$k = \frac{420\ Q}{rh}$$

Q is the water loss in gpm

r is the radius of the casing

h is same as above

Permeability tests were taken in soil in the area cleared by the split spoon sampler.

3. Casing was advanced into rock. This was loose rock, generally fault breccia that would cave without casing.

4. In test pits within the foundation area the pocket penetrometer was used to obtain a rough estimate of the bearing strength of the soil. These readings are to be taken only as a guide.

5 Soils to be used as fill material are classified according to the U. S. Department of Agriculture system of soil classification in addition to the unified system for each layer. The use of the former soil classification system is to group soils into sampled divisions.

The origin of these soils are:

Bucks series - Deeply weathered residual from Triassic sandstone and shale

Lloyd series - Deeply weathered residual from greenstone

Wilkes series - Shallow residual from greenstone

Elioak series - Deep red residual from mica schist

Glenelg series - Moderately deep residual from mica schist

Alluvial soil occurs in the stream valleys. It is generally young with an established profile.

Augusta series - Low terrace alluvium

Centerline of the Dam

The centerline of the dam was moved 168 feet upstream. Two "dog legs" were placed in this new centerline of the dam. On the right abutment at station 3+65 a 29° angle downstream was implaced in the dam centerline. On the left abutment at station 9+50 a 24° 20' angle downstream was implaced in the dam centerline.

Triassic sediments and late Precambrian greenstone are the rock types occurring on the centerline of the dam.

Bull Run shale and overlying Manassas sandstone are the formations present on the right abutment from station 1+05 on the dam centerline to the top of the dam. These Triassic formations are thrust over greenstone by a fault that has 22.5 feet of brecciated greenstone.

Below this fault blue green hard greenstone occurs. At station 2+17 on the centerline of the dam a fault implaces Manassas sandstone below Catoctin greenstone. In the area between station 2+50 and station 3+50 on the dam centerline 3 faults are present.

From station 2+75 to station 8+50 on the dam centerline Catoctin greenstone occurs. This formation has interspersed in the epidote, hornblende, chlorite, feldspar and quartz greenstone areas of light green feldsparsite.

Two faults occur in this area. The more northern of these is a low angle fault that has 23.2 feet of brecciated material dipping southward.

From station 8+50 to station 11+50 on the dam centerline Catoctin chlorite schist and high chlorite greenstone occur.

Above the Catoctin chlorite schist and high chlorite greenstone Triassic siltstone of the Bull Run formation occurs to the left of station 11+50 on the centerline of the dam. The contact between these formations is assumed to be a fault contact. The fault plane is above elevation 375.0.

Weathered sandstone talus that has disintegrated into a yellow red and red silty sand (SM) occurs on the right abutment from station 3+75 to the top of the dam. This soil is hard moist talus colluvium. The soil ranges from 23.0 to 35.0 feet in depth.

From station 3+75 to station 7+45 on the dam centerline alluvial to recent alluvial soil occurs. This soil generally has 3.0 feet of red brown ML overlying 0 to 2.0 feet of gray CL and 3.0 feet of gray wet SM or GM. The alluvium ranges up to 13.0 feet in depth.

Residual soil weathered from fractured greenstone and greenstone breccia occurs on the left abutment from station 7+45 to station 11+50 on the dam centerline. This soil has generally 4.0 feet of yellow red clayey silt (ML) overlying 3.0 feet of yellow red silty sand (SM) over weathered greenstone and saprolite. The depth of soil ranges from 8.0 feet to 25.0 feet.

From station 11+50 to the outside edge of the emergency spillway cut residual soil weathered from siltstone occurs. This soil has 3.5 to 8.0 feet of red to yellow brown hard clayey silt (ML to MH and SM) over weathered siltstone.

To investigate the centerline of the dam 11 drill holes and 15 test pits were emplaced. The drill holes are numbered DH 41 through DH 51. The test pits are numbered TP 20 through TP 32 with TP 14 and AT 201.

Centerline of the Pipe

The centerline of the pipe crosses the centerline of the dam at station 4+77.87 on the centerline of the dam and station 1+34.30 on the centerline of the pipe. These centerlines intersect with an angle of 86° 04'.

The centerline of the pipe is placed on the Catoctin greenstone formation. Within this formation a layer of purple phyllite (metamorphosed acid lava) occurs at station 1+65 on the pipe centerline.

A fault is present within the greenstone from station 2+63 to station 3+43 on the centerline of the pipe.

A second fault present at station 4+50 on the pipe centerline thrusts Triassic sandstone over Catoctin greenstone.

Alluvial soil is present on the centerline of the pipe. This alluvium has generally 3.0 feet of red brown sandy silt with clay (ML) overlying gray clay and sand (CL and SM). Below this is wet gravel (GM and SM). Weathered greenstone, weathered greenstone fault breccia, and weathered phyllite occur above the unweathered rock. The depth of this alluvium and weathered rock ranges from 6.0 to 13.0 feet.

To investigate the centerline of the pipe 16 test pits and one drill hole were used. These test pits are numbered TP 301 through TP 310 and TP 320 through TP 324. The drill hole is DH 31.

Foundation

Foundation conditions approximate those conditions described on the centerline of the dam and on the centerline of the pipe. A difference is that in the area of TP 520 and 521 GM material from an old dam foundation is present. This GM material is composed of angular well-graded greenstone cobbles. This old dam foundation is covered by at least 3.5 feet of alluvium.

Emergency Spillway

The centerline of the emergency spillway crosses the centerline of the dam at station 11+80 on the dam centerline and station 5+18 on the centerline of the emergency spillway. These centerlines form a right angle.

The only known location in the emergency spillway where unweathered rock occurs above grade is at station 11+25 on the inside edge of the cut. Here in TP 6, 8.0 feet of fractured Triassic sandstone occur above grade.

Upstream of station 4+25 on the emergency spillway centerline residual soil weathered from Catoctin greenstone is present.

Wilkes series occurs upstream from station 2+50 on the emergency spillway centerline. This is shallow soil having 1.5 feet of brown to yellow red ML over weathered fractured greenstone.

Lloyd series or deep greenstone residuum occurs from station 2+50 to station 4+25 on the emergency spillway centerline. This is deep greenstone residual soil. It has 3.5 feet of yellow red clayey silt (ML or MH) over at least 4.5 feet of red brown and yellow red silty, slightly plastic sand (SM).

Downstream from station 4+25 on the centerline of the emergency spillway Bucks series soil occurs. This soil weathered from Triassic siltstone, has 4.0 feet of red clayey silt (ML or MH) above from 0 to 5.5 feet of yellow brown sandy silt (ML or SM). Below these layers is highly weathered to weathered soft siltstone.

To investigate the emergency spillway cut 15 test pits and 6 hand auger holes were dug. The hand auger holes are numbered AH 210 through AH 215. The test pits are numbered TP 6 through TP 14, TP 201 through TP 205 and TP 101.

Borrow Area

The borrow area is located upstream from the centerline of the dam.

Alluvial soil occurs in the flood plain area. This soil has generally 3.0 feet of brown ML and 2.0 feet of CL over layers of sand and gravel (SM and GM). The water table of this alluvium ranges in depth from 3.0 to 9.0 feet.

On the right side of the stream valley steep greenstone rockland is present.

Around the other slopes bordering the flood plain residual soil and low bench soil occur.

The bench soil is Augusta series. This soil has at least 8.0 feet of red, yellow brown and gray mottled hard clayey silt with rounded gravels (ML).

The residual soil weathered from greenstone is the Lloyd series. This soil has 4.0 feet of red hard clayey silt (ML) above 4.0 feet of brown yellow clayey silt (ML). These layers are above nonplastic yellow silty sand or silt (ML or SM).

The residual soils weathered from Lynchburg mica schist and phyllite are the Glenelg and Elioak soil series. These series are generally similar with the Elioak series being redder and deeper weathered. These soils have 3.5 feet of yellow red to brown yellow sandy silt (ML) over at least 7.0 feet of silty sand (SM). The Elioak and Glenelg series soils are less plastic than the Lloyd series.

To investigate the borrow area 32 test pits and 39 hand auger holes were dug. The test pits are numbered TP 101 through TP 132. The hand auger holes are numbered AH 135 through AH 143 and AH 170 through AH 199.

Roberts, Joseph K. 1928 Geology of the Virginia Triassic: Virginia Geology Survey Bull. 29 205 p.

Stose, George Willis, 1927. Possible Post Cretaceous Faulting in the Appalachians: Geol. Soc. America Bull. Vol. 38, pp 493-404

MAY 55

UNIT) STATES DEPARTMENT OF AG 'ULTURE
SOIL CONSERVATION SERVICE

Sheet 13 of 15
VA 585-C

SOIL SAMPLE LIST
SOIL AND FOUNDATION INVESTIGATIONS

Location Culpeper County, Virginia Owner Glove, Yowell, Country Club
Town of Culpeper

Watershed Mountain Run Sub-watershed ______ Site No. ______

Submitted by Mack, T. Date 10 1969

Sent by Truck (carrier) Government B/L No. ______

Lab. No.	Field Sample No.	Sample Description		Depth		Type of Sample	
		Location	Grid or Station	From	To	Undist.	Dist.
	11-1	EMS	105' R 11+43 & Dam	1.0	3.5		Large
	11-2	"	"	3.5	9.0		"
	12-1	"	73' R 12+22 & Dam	3.8	12.5		"
	21-1	& Dam	09' R 6+61 & Dam	1.0	2.0	gal can	
	21-2	"	"	4.0	5.0	"	
	22-1	"	6+51 & Dam	7.0	10.2		Small
	24-1	"	7+85 & Dam	1.8	4.8		"
	25-1	"	04' L 8+67 & Dam	1.0	4.3		"
	26-1	"	04' L 8+29 & Dam	3.1	7.3		"
	29-1	"	5+16 & Dam	1.0	2.0	"	
	29-2	"	"	2.5	3.5	"	
	31-1	"	39' L 3+33 & Dam	3.0	4.0	"	
	31-2	"	"	5.0	6.0	"	
	102-1	Borrow Area	395' L 6+30 B/L B	1.0	4.3		Large
	103-1	"	330 L 43+35 B/L B	3.0	11.0		"
	107-1	"	10' L 37+65 B/L B	4.8	7.2		"
	112-1	"	385' R 45+63 B/L B	4.0	8.0		"
	114-1	"	84' L 262+83 B/L A	3.3	6.6		"
	117-1	"	117' L 260+60 B/A	1.0	2.7		"
	120-1	"	628' L 261+88 B/L A	1.0	4.2		"
	152-1	"	585' R 249+90 B/L A	6.2	8.1		"
	152-2	"	"	8.1	10.5		"
	154-1	"	480' R 253+30 B/L A	1.0	8.2		"
	171-1	"	673' L 38+95 B/L B	1.0	8.0		"

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Distribute other copies as directed by State Conservationist Sheet ___ of ___ Sheets

Form SCS-534
MAY 55

UNI D STATES DEPARTMENT ~~OF A~~ CULTURE
SOIL CONSERVATION SERVICE

Sheet 14 of 15
VA 585-G

SOIL SAMPLE LIST
SOIL AND FOUNDATION INVESTIGATIONS

Location Culpeper County, Virginia Owner Clove, Yowell, Country Club / Town of Culpeper

Watershed Mountain Run Sub-watershed ______ Site No. ______

Submitted by Mack, T. Date 10 1969

Sent by Truck (carrier) Government B/L No. ______

Lab. No.	Field Sample No.	Sample Description: Location	Sample Description: Grid or Station	Depth: From	Depth: To	Type of Sample: Undist.	Type of Sample: Dist.
	202 1	EMS	130' L 13+00 & Dam	2.3	9.0		Large
	210-1	EMS	120' L 13+03 & Dam	1.0	4.0		"
	212 1	EMS	282' L 12+36 & Dam	4.0	8.5		"
	309-1	& Pipe	2+50 & Pipe	3.5	4.5		"
	309 2	"	"	6.2	9.3		"
	322 1	"	2+00 & Pipe	2.0	3.0	gal can	
	324-1	"	0+70 & Pipe	2.0	3.0	"	
	402 1	Foundation	43' L 7+78 & Dam	6.1	7.0		Small
	520 1	"	70' R 6+15 & Dam	1.0	5.3		Large

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Geologic Map

Site No. 50 Mountain Run Watershed

Culpeper County, Virginia

Geology by Mack, T.

Triassic

Triassic diabase & lava

Trd

Triassic Manassas sandstone

Trm

Triassic Bull Run siltstone & shale

Trbr

Triassic Border conglomerate

Trbc

Precambrian-Cambrian greenstone

pCc

Precambrian Lynchburg mica schist

pCly

Precambrian Lovingston Granite gneiss & Granodiorite

pCl

Formation contacts (approximate)

Faults thrust

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-376C
REV. 7-64
SHEET 1 OF 15
VA 585-C

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED		SUBWATERSHED	COUNTY	STATE	
Mountain Run		--	Culpeper	Virginia	
SITE NO.	SITE GROUP	STRUCTURE CLASS	INVESTIGATED BY: (SIGNATURE OF GEOLOGIST)		DATE
50	I	C	[illegible signature]		10/69

INTERPRETATIONS AND CONCLUSIONS

1. The centerline of the dam was moved upstream to obtain a safer foundation. However, the selected foundation still has faults present. These are considered to be thrust faults with two transverse faults. Always these faults must be considered as dangerous as to the passing of water under the dam structure and the subsequent draining of the water supply pool.

   It is suggested that a deep cut-off be emplaced. This would remove much of the greenstone fault breccia under the foundation. A profile of the dam is given with a suggested cut-off depth.

   With the emplacement of this deep cut-off grouting of the fault zones will probably be unnecessary. Some water may pass through these zones but the leakage should not be sufficient to endanger the water supply pool.

   If it is found necessary to grout the fault planes in the foundation area the grout area would probably be extensive as these faults are large features and extend for considerable depths and horizontal distances.

   Grouting this fault zone could easily prove unreasonably expensive.

   Distinction should be made here of the difference between fracture permeability and fault plane permeability.

   Fracture permeability rarely passes water through the foundation area. The reason for this is that fractures and joints in a competent rock such as greenstone are generally at a 90° angle. Thus the water passing through the rock must make innumerable turns with stoppages at sealed fracture planes.

   Fault plane permeability can easily pass water under the dam. This is because the fault gives a passage plane of broken brecciated rock that allows water to pass along the plane surfaces. However, fault planes are diverse in permeability. Many faults are tightly resealed with the brecciated pieces cementated together with quartz, calcite, or iron oxide. Clay can pack into a fault plane to reseal the breccia. Fault plane permeabilities range from zero to very high. Permeability tests do not always show the true permeability condition as the breccia can be resealed by solutions in one area and entirely open due to lack of solutions in another area several yards distant.

Summing up it can be said that every fault is treacherously dangerous. Water passage through fault planes is among the major causes of large dam failures in the Virginia Piedmont and Blue Ridge.

2. With the pipe invert assumed to be at 366.3, the pipe will be placed at approximate ground level. A deep clay cushion will have to be placed below the pipe to the top of rock.

3. A small amount of rock excavation is expected in the emergency spillway cut. This will be weathered Triassic sandstone rock occurring on the inside edge of the cut at 150 feet right of station 11+25 on the centerline of the emergency spillway. The excavation is expected to be less than 140 cubic yards.

If the designer wishes to dodge this fractured sandstone, he may angle the centerline of the emergency spillway to the left to miss this sandstone. Moving the centerline 60 feet to the left at station 11+25 on the emergency spillway centerline should be sufficient to dodge this sandstone rock.

4. A toe drain should be emplaced to receive the water passing under the structure.

5. Sufficient borrow is available to construct the embankment.

Suggested placement of the borrow as outlined by horizons of soil series is given in the soil correlation chart.

A soil map and an isopach map are given in the 35's. The isopach map gives the depth of soil present as assumed from the top of unusable rock or from the water table.

The thickness of the layer of soil that can be excavated with pans will be from 1 1/2 to 2 1/2 feet less than the depth of the soil as shown on the isopach map. This will be for the following reasons:

a. At least one half a foot of topsoil will have to be removed. This topsoil will be one half a foot thick in the fields and at least a foot thick in wooded areas. This greater depth in the woods is due to the trouble in removing tree roots from the soil.

b. Heavy equipment tends to mire up in soft alluvium before the water table is reached. Thus a pan would have difficulty even crossing a wet bottom although the water table were three feet below the surface.

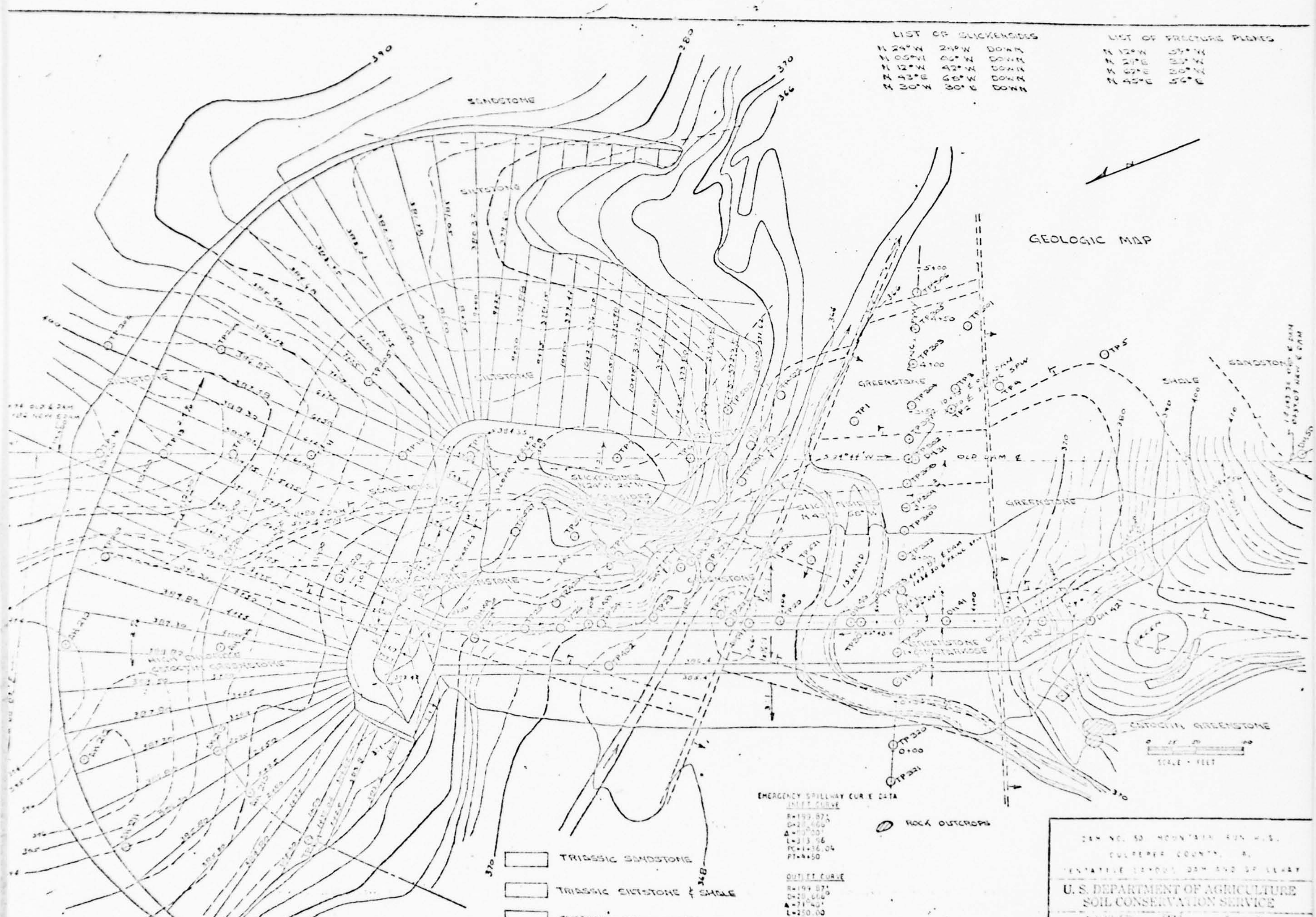
The alluvial soil can be drained with ditches installed after excavation of the dry top alluvium. However this is time consuming and is not generally done by local contractors except in cases of short borrow.

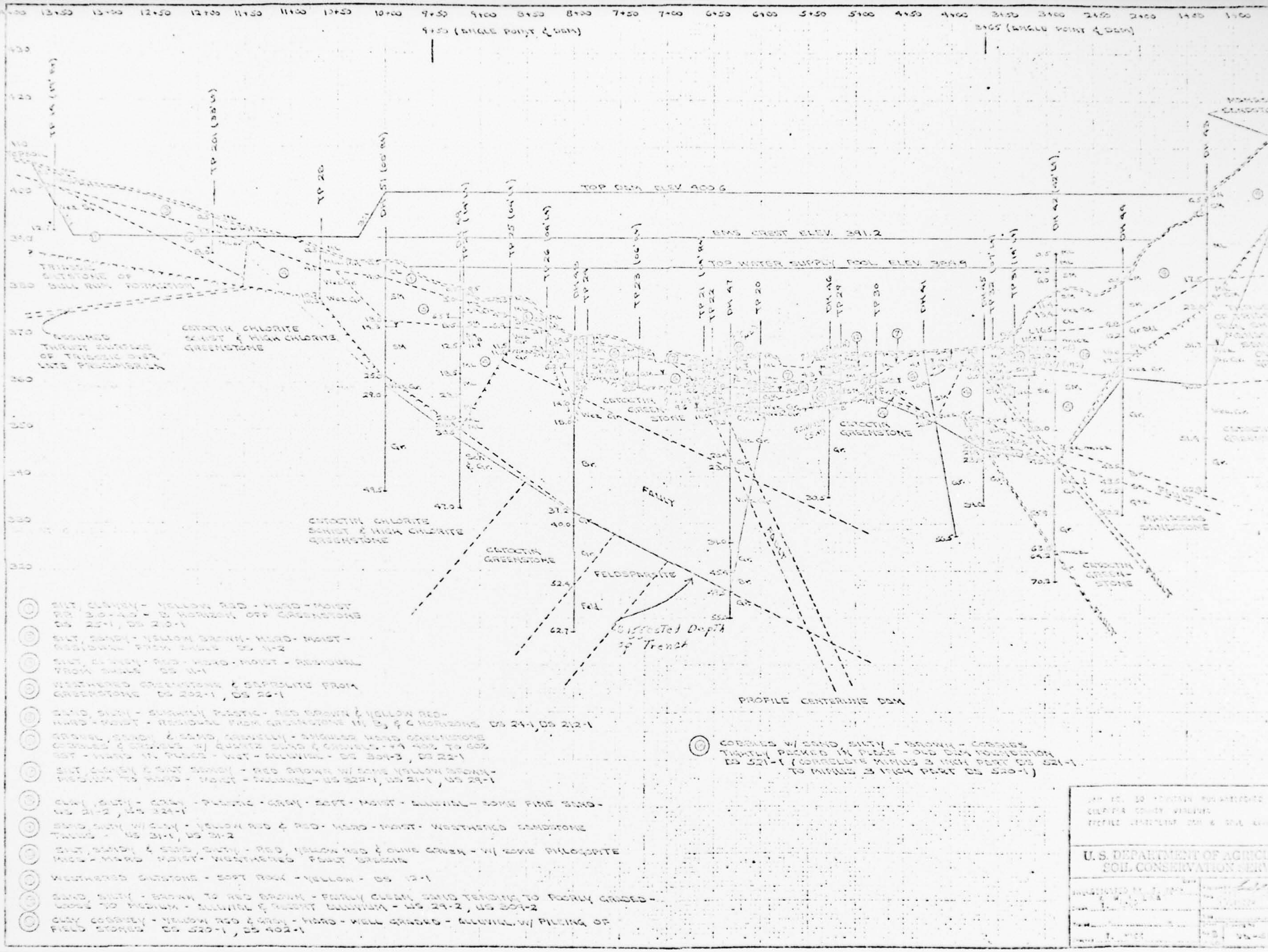
The amount of borrow obtained from the alluvial areas depends largely on the time of year of embankment construction. The generally dry late summers and autumns of Virginia would be the best time to excavate maximum material from the alluvial borrow areas.

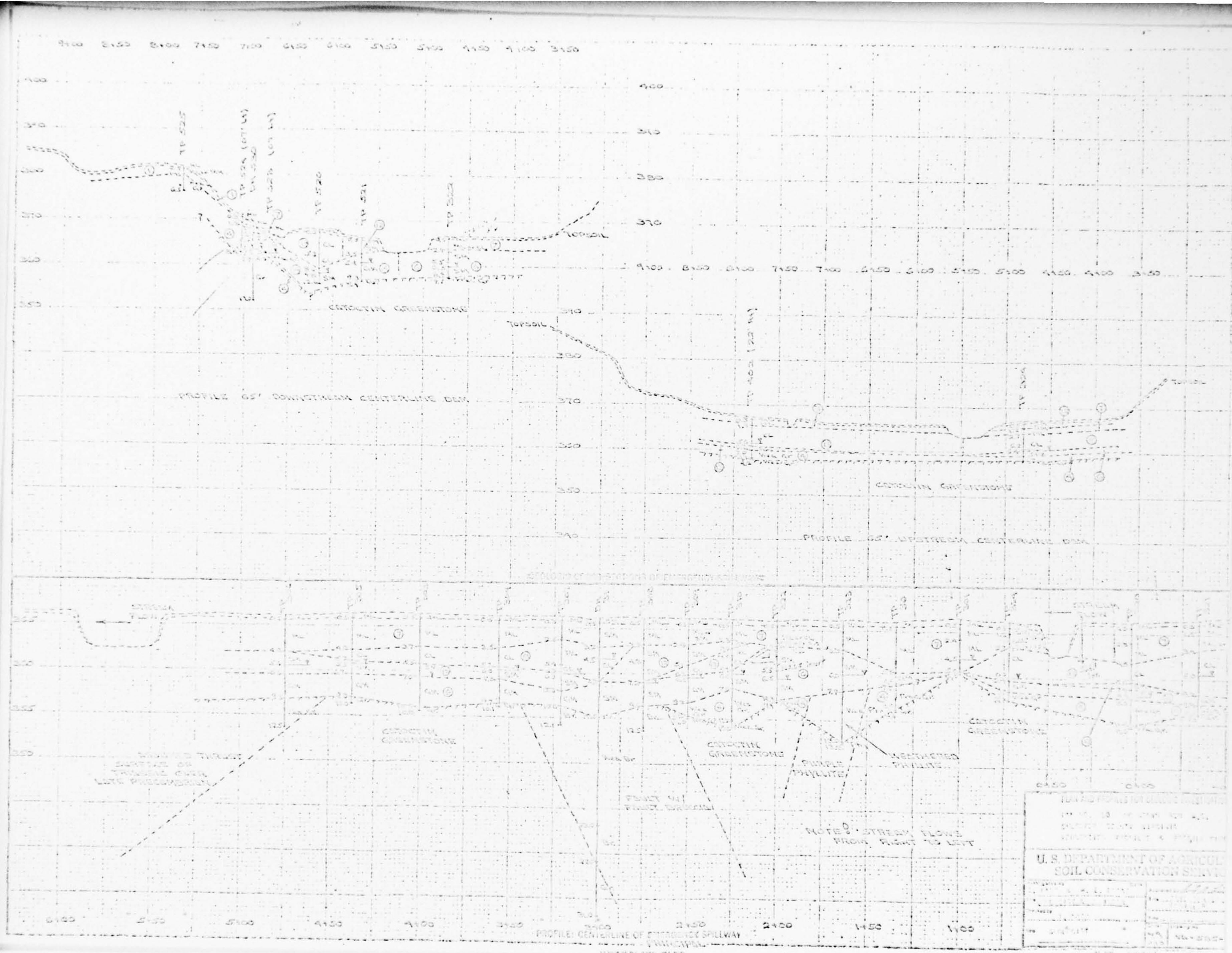
c. In the residual soil borrow areas the irregularities in the depth to top of rock limit the amount of available borrow. Considerable borrow can be left in pockets between knobs of hard unweathered rock.

6. Considerable borrow can be obtained beyond the limit of the permanent pool by excavating back from the edge of the permanent pool and sloping the borrow pit sides back on a 3 to 1 slope. This would enlarge the pool and lessen the danger of swampy areas by placing ground level at least two feet below water level around the permanent pool edges.

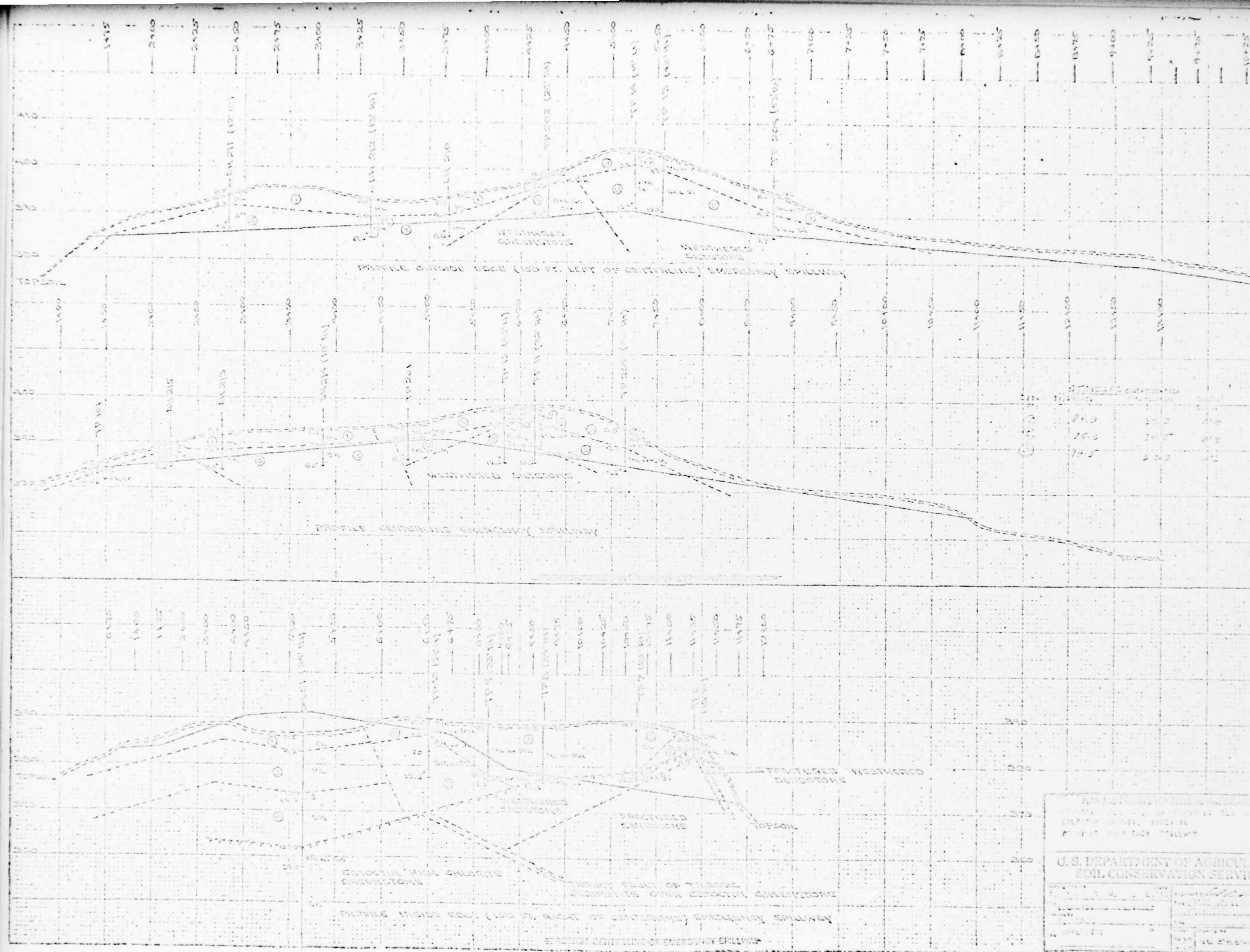
A good place for this extension of the permanent pool is on the left side of the permanent pool to the left of the small tributary stream. Also, any ridge with deep soil that enters the permanent pool can be excavated off for borrow and sloped back.


GEOLOGIC MAP
LIST OF SLICKENSIDES
N 24° W 24° W DOWN
N 05° W 06° W DOWN
N 12° W 42° W DOWN
N 43° E 68° W DOWN
N 30° W 30° E DOWN
LIST OF FRACTURE PLANES
N 12° W
N 29° E 33° W
N 67° E 30° W
N 45° E 56° E
SANDSTONE
SILTSTONE
SHALE
GREENSTONE
ISLAND
CATOCTIN GREENSTONE
OLD DAM
TP 102
LYNCHBURG MICA SCHIST
TP 320
0+00
TP 321
EMERGENCY SPILLWAY CURVE DATA
INLET CURVE
L=313.96
PC=1+36.04
PT=4+50
OUTLET CURVE
L=250.00
PC=6+75
PT=9+25
ROCK OUTCROPS
TRIASSIC SANDSTONE
TRIASSIC SILTSTONE & SHALE
CATOCTIN GREENSTONE
FAULT BRECCIA
LYNCHBURG MICA SCHIST
SCALE - FEET
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
R.E. CURTISS
R.E. CURTISS


9+50 (ANGLE POINT ℄ DAM)
3+65 (ANGLE POINT ℄ DAM)
TOP DAM ELEV. 400.6
EMS CREST ELEV. 391.2
TOP WATER SUPPLY POOL ELEV. 384.9
TP 201
TP 20
DH 51
TP 25
TP 26
DH 40
TP 24
TP 23
TP 21
TP 22
DH 47
DH 46
TP 29
TP 30
DH 41
DH 45
TP 32
TP 31
DH 42
DH 49
DH 43
TRIASSIC SILTSTONE OF BULL RUN FORMATION
ASSUMED THRUST CONTACT OF TRIASSIC OVER LATE PRECAMBRIAN
CATOCTIN CHLORITE SCHIST & HIGH CHLORITE GREENSTONE
CATOCTIN GREENSTONE
FELDSPARSITE
FAULT
Suggested Depth of Trench
PROFILE CENTERLINE DAM
SILT, CLAYEY - YELLOW RED - HARD - MOIST PP 3.0-4.0 - B HORIZON OFF GREENSTONE DS 25-1, DS 210-1
SILT, SANDY - YELLOW BROWN - HARD - MOIST - RESIDUAL FROM SHALE DS 11-2
SILT, CLAYEY - RED - HARD - MOIST - RESIDUAL FROM SHALE DS 11-1
WEATHERED GREENSTONE & SAPROLITE FROM GREENSTONE DS 202-1, DS 26-1
SAND, SILTY - SLIGHTLY PLASTIC - RED BROWN & YELLOW RED - HARD - MOIST - RESIDUAL FROM GREENSTONE IN B, & C HORIZONS DS 24-1, DS 212-1
GRAVEL, SANDY & SAND, GRAVELLY - ANGULAR HARD GREENSTONE COBBLES & GRAVELS W/ QUARTZ SAND & GRAVELS - +4 40% TO 60% SOFT - HARD IN PLACE - WET - ALLUVIAL - DS 304-3, DS 22-1
SILT, CLAYEY & SILT SANDY - RED BROWN W/ SOME YELLOW BROWN - MEDIUM TO HARD - MOIST - ALLUVIAL - US 227-1, US 21-1, US 29-1
CLAY, SILTY - GRAY - PLASTIC - GRAY - SOFT - MOIST - ALLUVIAL - SOME FINE SAND - US 21-2, US 224-1
SAND, SILTY W/ CLAY - YELLOW RED & RED - HARD - MOIST - WEATHERED SANDSTONE TALUS - US 31-1, US 31-2
SILT, SANDY & SAND, SILTY - RED, YELLOW RED & OLIVE GREEN - W/ SOME PHLOGOPITE MICA - HARD MOIST - WEATHERED FAULT BRECCIA
WEATHERED SILTSTONE - SOFT ROCK - YELLOW - DS 12-1
SAND, SILTY - BROWN TO RED BROWN - FAIRLY CLEAN SAND TENDING TO POORLY GRADED - LOOSE TO MEDIUM - ALLUVIAL & RECENT ALLUVIUM - US 29-2, US 209-2
CLAY COBBLEY - YELLOW RED & GRAY - HARD - WELL GRADED - ALLUVIAL W/ PILING OF FIELD STONES DS 520-1, DS 402-1
COBBLES W/ SAND, SILTY - BROWN - COBBLES TIGHTLY PACKED IN PLACE - OLD DAM FOUNDATION DS 321-1 (CORRELATE MINUS 3 INCH PART DS 321-1 TO MINUS 3 INCH PART DS 520-1)
U.S. DEPARTMENT OF AGRICU
SOIL CONSERVATION SERVI



PROFILE 65' DOWNSTREAM CENTERLINE DAM
CATOCTIN GREENSTONE
TOPSOIL
PROFILE 65' UPSTREAM CENTERLINE DAM
CATOCTIN GREENSTONE
PURPLE PHYLLITE
WEATHERED PHYLLITE
NOTE: STREAM FLOWS FROM RIGHT TO LEFT
PROFILE: CENTERLINE OF EMERGENCY SPILLWAY
U.S. DEPARTMENT OF AGRICUL
SOIL CONSERVATION SERVI



PROFILE OUTSIDE EDGE (150 FT. LEFT OF CENTERLINE) EMERGENCY SPILLWAY
WEATHERED SILTSTONE
TOPSOIL
PROFILE CENTERLINE EMERGENCY SPILLWAY
WEATHERED SILTSTONE
PROFILE INSIDE EDGE (150 FT. RIGHT OF CENTERLINE) EMERGENCY SPILLWAY
FRACTURED WEATHERED SILTSTONE
FRACTURED SILTSTONE
EPIDOTIC AND CHLORITIC GREENSTONE
U.S. DEPARTMENT OF AGRICUL
SOIL CONSERVATION SERVIC

APPENDIX V - STABILITY ANALYSIS SUMMARY

Referring to Appendix VI, Reference 2, the conditions used for stability analysis and the results were as follows:

Width of crest: 14 feet
Elevation of crest: 400.6 ft.
Downstream slope: 1 vertical on 2½ horizontal to toe at El. 363.5
Upstream slope: 1 vertical on 2½ horizontal to El. 386.9
1 vertical on 10 horizontal to El. 385.9
1 vertical on 3 horizontal to El. 363.5
Elevation of emergency spillway crest: 391.2'
Thickness of foundation materials: Upper layer - 4 ft.
Lower layer - 4 ft.
Seepage drain at c/b = 0.6

Soil Data:

Item	Classification	Dry unit wt. pcf	wet unit wt. pcf	sat. unit wt. pcf	sub. unit wt. pcf	ϕ_{cu} degree	C_{cu} psf
Embankment	ML-MH	90.4	115.0	120.5	58.0	19	1150
Foundation upper layer	ML	66.2	-	105.0	42.5	15.5	800
Foundation lower layer	SM	86.3	-	117.0	54.5	22	150

Loading Condition: Pool level at emergency spillway crest.

Minimum factor of safety:

Method	Maximum drawdown Upstream slope	Maximum steady seepage Downstream slope
Swedish circle	2.54	2.10
Sliding block	1.42	1.50

APPENDIX VI

DESIGN REPORT

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE - Soil Mechanics Laboratory

800 "J" Street, Lincoln, Nebraska 68508

SUBJECT: ENG 22-5, Virginia WP-08, Mountain Run, Site 50 (Culpeper County)

DATE: February 9, 1970

TO: Louis S. Button, Jr., State Conservation Engineer
SCS, Richmond, Virginia

ATTACHMENTS

1. Form SCS-354, Soil Mechanics Laboratory Data, 6 sheets.
2. Form SCS-128 and SCS-128A, Consolidation Test Data, 2 tests, 6 sheets.
3. Form SCS-127, Soil Permeability, 2 sheets.
4. Form SCS-355A, Triaxial Shear Test Data, 4 sheets.
5. Form SCS-352, Compaction and Penetration Resistance, 12 sheets.
6. Form SCS-357, Summary - Slope Stability Analysis, 3 sheets.
7. Investigational Plans and Profiles.

DISCUSSION

FOUNDATION

A. Bedrock. The bedrock at this site is a complex system of sandstone, shale, siltstone, and greenstone. Faults and fault breccia zones were encountered. The faults are considered to be both thrust and transverse faults. Refer to the geology report for a discussion on the bedrock.

The bedrock on the right abutment is mantled with about 17 to 20 feet of weathered sandstone talus and fault breccia. In the floodplain section alluvium ranging from about 6 feet thick to 19 feet thick overlies the bedrock. In the left abutment residual soil and saprolite ranging from about 10 feet thick to about 30 feet thick overlie the bedrock.

A significant thickness of fault breccia was encountered in DH 48 at ₵ station 8+00. In this test hole this zone extends from a depth of 18 feet to a depth of 37.2 feet, and it is logged as coarse to medium sand-size pieces.

B. Soil Classification. Nine samples of alluvium were submitted from the centerline of dam and the centerline of the principal spillway. The alluvium is logged as GM, SM, CL, and ML. The samples submitted contain from 15 percent to 99 percent fines, and they are classed as SM, ML, CL-ML, and MH.

Three samples of residual soil and saprolite were submitted from the lower left abutment. Sample 26-1, representing weathered greenstone, contained 85 percent plus No. 4 size material as received; Sample 25-1,

representing material at the surface, contained 79 percent fines; and Sample 24.1, representing an intermediate zone of weathering, contained 39 percent fines.

The gradation of these samples is shown on the attached Form SCS-354 along with Atterberg limits for some of the samples.

The log of borings shows that some of the alluvium contains 40 to 60 percent plus No. 4 size material.

C. Density. Nine hand-sampled, undisturbed cores were submitted to the Laboratory. Seven of the cores are from the alluvium and two of the cores (31-1 and 31-2) are from a zone described as weathered sandstone talus. Test specimens trimmed from the cores submitted had the following densities:

Sample	Classification	Density g/cc	Density pcf
309-1	SM	1.32-1.41	82.4-88.0
322-1	ML	1.33-1.37	83.0-85.5
324-1	CL-ML	1.43-1.45	89.2-90.5
21-1	ML	1.53	95.5
21-2	ML	1.44	89.9
29-1	MH	1.24	77.4
29-2	SM	1.65	103.0
31-1	ML	1.00-1.08	62.4-67.4
31-2	ML	1.14-1.20	71.1-74.9

D. Shear Strength. Consolidated undrained triaxial shear tests were made on Samples 309-1 and 31-1. The natural water content was well below theoretical saturation, so the test specimens were soaked prior to testing and the degree of saturation was in the range of 90 percent on two of the specimens from Sample 1028 (309-1) and 82 percent on one of the specimens. These specimens contained fairly large pores, which we think resulted in the low degree of saturation. The degree of saturation of the specimens from Sample 31-1 were in the range of 91 to 96 percent of theoretical. The shear parameters have been interpreted as $\phi = 22°$, c = 150 psf for Sample 309-1, and $\phi = 15.5°$, c = 800 psf for Sample 31-1.

E. Consolidation. Consolidation tests were made on Samples 322-1 and 324-1. We had intended to make a consolidation test on Sample 309-1 also but we could not salvage enough sample after the shear specimens had been trimmed. The test data indicate that both Sample 322-1 and 324-1 have been preconsolidated slightly.

The data indicate that for the loading range planned a consolidation potential of about 0.04 ft/ft may be expected for material like Sample 322-1, and 0.05 ft/ft may be expected for material like 324-1. Based on the consolidation that occurred on the triaxial test specimens from Sample 309-1, about 0.06 ft/ft may be expected for this type of material. Some of the materials are not represented by samples and tests, but based on the present data we suggest an average value of 0.05 ft/ft be used to represent the alluvium for computation purposes.

F. Permeability. Permeability measurements were made on the consolidation specimens, and the data are shown on the attached Forms SCS-127. Cut-off through the alluvium is planned, however. The investigation report points out that the primary concern with foundation permeability at this site is in the fault breccia zones which occur to depths in the range of 40 feet.

EMBANKMENT

A. Classification. Seventeen samples of available borrow materials from the emergency spillway and from the borrow area were submitted to the Laboratory for testing.

Four samples of soil and two samples of weathered bedrock were submitted from the emergency spillway. The soil samples submitted contain from 65 percent to 88 percent fines. Two of the samples are classed as MH and the other two are ML. The sample of weathered siltstone contained 95 percent plus No. 4 size and the sample of weathered greenstone contained 86 percent plus No. 4 size as received.

Three of the samples submitted from the borrow area contain 25 percent or less fines and they are classed as SM, SP-SM, and GP-GM. The remainder of the samples from the borrow area are fine-grained. They contain from 64 percent to 95 percent fines. They are classed as ML and MH. The ML's have liquid limits of 35 to 45 and PI's from 5 to 16. The MH's have LL's of 56 to 89 and PI's of 22 to 42. Two of the samples are intermediate between ML and MH. They have liquid limits of 50 and PI's of 15 and 18.

B. Compacted Density. Standard Proctor compaction tests were made on twelve of the borrow samples submitted. The tests were made on the minus No. 4 fraction. The maximum dry density obtained on the SM was 104 pcf. The ML's had maximum dry densities from 91.5 pcf to 107 pcf. The maximum dry density of the MH's ranged from 80.5 pcf to 97.5 pcf, and the maximum dry densities obtained on the samples classed as ML or MH were 95 and 97.5 pcf.

The weathered bedrock, the SP, and the GP-GM represent small quantities, and compaction tests were not made on these samples.

C. Shear Strength. Consolidated undrained triaxial shear tests were made on Samples 111-2 and 154-1. It is considered that the tests on these two samples give a good representation on about 65,000 cubic yards of the proposed 110,000 cubic yard fill. The test on 154-1 is considered to be representative of Sample 120-1 and 171-1 as well.

The tests were made at 95 percent of Proctor density with a degree of saturation in the range of about 93 to 96 percent. The shear parameters obtained are $\phi = 23.5°$, $c = 1250$ psf for Sample 112-1, and $\phi = 19°$, $c = 1150$ psf for Sample 154-1.

SLOPE STABILITY

The stability of the proposed slopes was checked with a Swedish circle method of analysis and with a sliding block method of analysis. The bedrock was of course assumed to have adequate strength for the embankment planned and breccia zones are described as too hard to drive sample, so these were also assumed to have adequate shear strength for the analysis. The alluvium is quite variable and irregularly stratified. The data indicate that the SM like Sample 309-1 is the most critical from a shear strength standpoint, and although the most extensive deposit appears to be downstream from the base area, there are thin deposits in both DH 320 and TP 29. For this analysis the alluvium was represented with a four-foot thickness of $\phi = 15.5°$, $c = 800$ psf material overlying a four-foot thickness of $\phi = 22°$, $c = 150$ psf material.

The sliding block analysis showed the lowest factor of safety for the proposed slopes. With the full drawdown condition assumed, the 2 1/2:1 over 3:1 upstream slope has a factor of safety of 1.42. The 2 1/2:1 downstream slope with the steady seepage condition assumed and a drain at c/b = 0.6 has a factor of safety of 1.50. A summary of the stability analysis is attached on Forms SCS-357 and 315A.

CONCLUSIONS AND RECOMMENDATIONS

A. Site Factors. The bedrock at the site has been subjected to considerable faulting and there are some fairly extensive breccia zones that are suspected of being quite variable and highly permeable in some places. Because of the intense and diversified nature of the faulting, very little is known about the actual conditions of the bedrock. It is considered, however, that there is a very good possibility that high seepage losses may occur through the fault zones.

B. Cutoff. Because of the uncertainty regarding the foundation conditions at this site a deep cutoff trench has been proposed to remove much of the greenstone fault breccia. The cutoff trench depths proposed in the field are shown on the attached Form SCS-315, sheet 8 of 10. We concur with the proposal for a deep cutoff trench to (1) insure cutoff in this unpredictable foundation, and (2) because of the necessity of providing an inspection trench to determine the drainage requirements for protecting the embankment.

Material like Samples 114-1, 120-1, 154-1, and 171-1 is preferred for backfill because it is expected that it would be easier to work with than the MH material. We suggest that the backfill material be compacted to a minimum of 95 percent of standard Proctor density with a placement moisture content near optimum.

C. Principal Spillway. The proposed principal spillway location crosses the centerline of dam at about Station 4+75. The alluvium overlying bedrock and weathered bedrock ranges from about 5 feet thick to about 8 feet thick. The test data available indicate a consolidation potential in the range of 0.05 ft/ft may be expected in the alluvium.

The channel crosses this alignment near the upper end and we suggest that the conduit be excavated to at least the depth of the channel to provide a uniform foundation.

The potential horizontal strain at ground surface at this location is expected to be in the range of 0.006 ft/ft.

D. Drain. The bedrock has a complex faulting pattern, and the geologist indicated that the faulting was so intense and diversified that interpretations based on present data were problematical at best.

We think that the conditions at this site warrant a fairly extensive drainage system even though a deep cutoff is planned. Tentatively we suggest a wider-than-normal trench drain that bottoms on bedrock. The location will be somewhat variable in the floodplain section depending on the slopes required for the cutoff trench. The final determination of the drainage requirements can be best determined after the core trench is excavated and the conditions have been determined by actual inspection.

With the cutoff planned the foundation seepage that will be of concern will be through the bedrock or the breccia zones. We suggest, therefore, that you consider a pervious drain fill such as ASTM No. 78 or 89 coarse aggregate for the drain with a transition zone like ASTM fine concrete aggregate between the embankment material and the coarser drain fill.

E. Embankment Design.

1. Placement of Materials. We suggest selective placement of materials during construction to restrict the placement of the MH material to the interior sections of the embankment where it will not be subjected to wetting and drying. The SM, SP-SM, and GP-GM like Samples 152-1 and 152-2 could be best utilized in the downstream section of the fill to facilitate drainage within the embankment. The ML's may of course be used in either the center or the exterior sections of the fill. With the exception of the GP-GM (152-2) and the weathered bedrock from the emergency spillway, we suggest that all of the embankment materials be placed at a minimum of 95 percent of standard Proctor density with the control based on the minus No. 4 fraction. Placement moisture content should be near optimum.

The weathered bedrock from the emergency spillway represents a small quantity and it can probably be utilized above the phreatic line in the downstream section. A methods specification could be used for the weathered bedrock and the GP-GM.

2. Slopes. The data and analyses indicate that the proposed 2 1/2:1 over 3:1 upstream slope and the 2 1/2:1 downstream slope have acceptable factors of safety.

3. Settlement. We suggest an overfill allowance of 1.0 foot to compensate for residual consolidation in the fill and foundation.

Prepared by:

Lorn P. Dunnigan

Lorn P. Dunnigan
Head, Soil Mechanics Laboratory

Attachments

cc:
Louis S. Button (4)
Neil F. Bogner, Upper Darby, Pa. (2)
Rey S. Decker, Lincoln, Nebr.

Form SCS 357
Rev. 6-65

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SUMMARY - SLOPE STABILITY ANALYSIS

PROJECT and STATE: Mountain Run, Site #50 Virginia

DATE: 2-4-70

METHOD OF ANALYSIS: Swedish Circle

ANALYZED AT: S. M. L.

APPROVED BY:

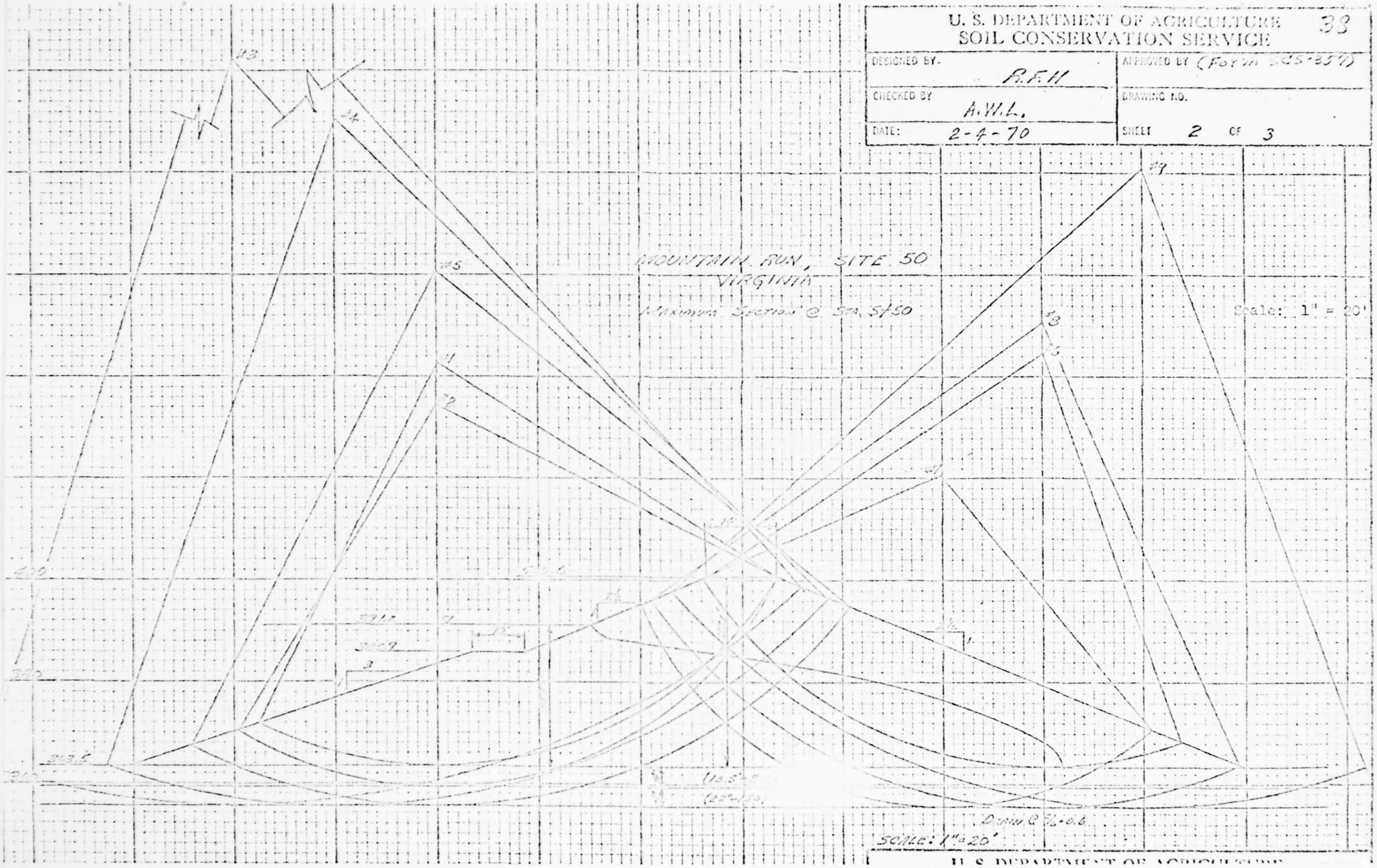
	SOURCE AND USE OF MATERIALS	CLASSIFICATION	γd (pcf)	γm (pcf)	γsat (pcf)	γsub (pcf)	φ (deg.)	tan φ	c (psf)	REMARKS
①	Foundation	SM	86.3		117.0	54.5	22	.404	150	
②	Foundation	ML	66.2		105.0	42.5	15.5	.277	800	
③	Embankment	ML	85.5	108.0	116.5	54.0	23.5	.435	1250	
④	Embankment	ML or MH	90.4	115.0	120.5	58.0	19	.344	1150	
⑤										
⑥										
⑦										
⑧										

TRIAL NO.	SLOPE	CONDITIONS	F_s
		Maximum Section @ Sta. 5+50	
1 up	2½:1/3:1	10' Berm @ Elev 385.9, Full Drawdown, Arc from opposite shoulder through Embankment (19°-1150) only.	3.7
2 up	2½:1/3:1	10' Berm @ Elev. 385.9, Full Drawdown, Arc from opposite shoulder through Embankment (19°-1150) and 4' Foundation (15.5°-800) only.	3.0
3 up	2½:1/3:1	10' Berm @ Elev 385.9, Full Drawdown, Arc from opposite slope through Embankment (19°-1150), 4' Foundation (15.5°-800) and 4' Foundation (22°-150).	2.4
4 up	"	Same conditions as trial #3	2.1
5 up	"	Same conditions as trial #3	2.3
6 Dn	2½:1	Drain @ c/b=0.6, Arc from opposite shoulder through Embankment (19°-1150) only.	3.4
7 Dn	2½:1	Drain @ c/b=0.6, Arc from opposite shoulder through Embankment (19°-1150), 4' Foundation (15.5°-800) and 4' Foundation (22°-150) only	2.5
8 Dn	2½:1	Same conditions as trial #7	2.1
9 Dn	2½:1	Same conditions as trial #8	2.2
		Block Analysis	
1 Dn	2½:1	Block #1 - Drain @ c/b=0.6 - No berm - Emb (19°-1150) & 4' found (15.5°-800) & 4' found (22°-150) sliding on (22°-150).	1.50
2 Dn	2½:1	Block #2 - Same conditions as block #1.	1.54
3 Up	2½:1/3:1	Block #3 - Full drawdown - 10' berm @ elev. 385.9 - Emb (19°-1150) & 4' found (15.5°-800) & 4' found (22°-150) sliding on (22°-150).	1.42

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE		33
DESIGNED BY: R.F.H.	APPROVED BY (Form SCS-357)	
CHECKED BY A.W.L.	DRAWING NO.	
DATE: 2-4-70	SHEET 2 OF 3	

MOUNTAIN RUN, SITE 50
VIRGINIA
Maximum Section @ Sta. 5+50

Scale: 1" = 20'



MOUNTAIN[illegible] 50
VIRGINIA

MAXIMUM SECTION
STATION 5+50

Scale: 1" = 20'

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
DESIGNED BY A.W.L.	APPROVED BY (Form SCS-3 57)
CHECKED BY R.F.H.	DRAWING NO.
DATE: 2-4-70	SHEET 3 OF 3

U. S. GOVERNMENT PRINTING OFFICE : 1957 O - 421471

Form SCS-313A (March 1957)

APPENDIX VII - REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Dept. of Army, Office of the Chief of Engineers.

2. Design of Small Dams, U.S. Department of Interior, Bureau of Reclamation.